

Chapter 3

Affected Environment



Overhanging snow on the Going-to-the-Sun Road

June 2002

The Affected Environment chapter provides baseline information on the environment potentially affected by the preferred alternative and other alternatives. The chapter is divided into three resource categories: socioeconomic resources, cultural resources, and natural resources. The analysis area for each of these resources varies. Although proposed rehabilitation and improvements to the Going-to-the-Sun Road are confined to a narrow corridor along the existing Road, indirect impacts for these actions may extend beyond the area of actual disturbance.

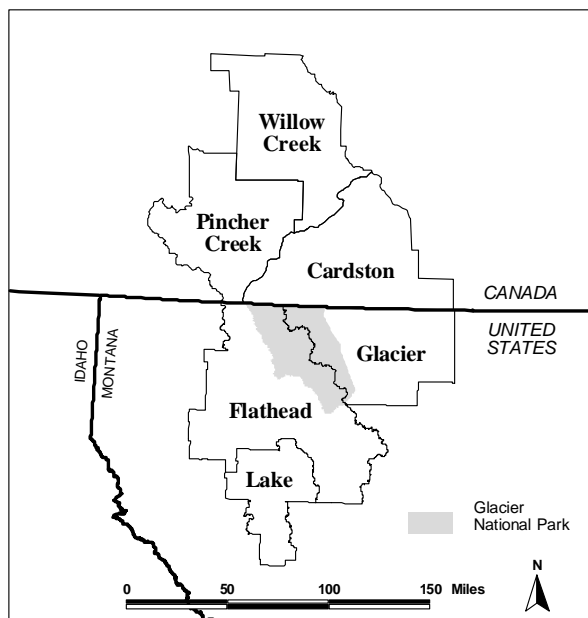
Visitor use and experience are linked primarily to access to the Road and associated amenities. The affected environment for economic impacts encompasses local and regional economies for three counties in Montana and the southwest portion of Alberta Province in Canada. For natural resources, the affected environment is broadly defined as the Going-to-the-Sun Road geographic area identified in the GMP (Figure 2). The affected environment for natural resources may extend outside of the immediate Road corridor for resources, such as wide ranging wildlife species. For cultural resources, the affected environment is more closely tied to the specific historic and archeological features along and adjacent to the Road.

SOCIOECONOMIC RESOURCES

GNP and Waterton Lakes National Park (WLNP), GNP's sister unit in the Waterton-Glacier International Peace Park complex, are key elements of the economic and social environment of communities in both the United States and Canada.

This section of the EIS provides background information on the existing socioeconomic conditions in the study area and is the basis for the impact analysis in the Environmental Consequences chapter. The study area for the socioeconomic analysis, as defined during the work of the CAC and Washington Infrastructure Services, includes Flathead, Glacier, and Lake counties in Montana and the municipal districts of Pincher Creek, Willow Creek, and Cardston in southwest Alberta; these are the areas most likely to be affected by rehabilitation of the Going-to-the-Sun Road (Figure 8).

Figure 8. Study Area for Socioeconomic Analysis.



Park Visitation and Operations

The following discussion describes GNP visitation trends and conditions, including historical and forecasted visitation levels, visitor characteristics, including their activities at GNP and their travel and spending patterns, and Park operations including expenditures and employment.

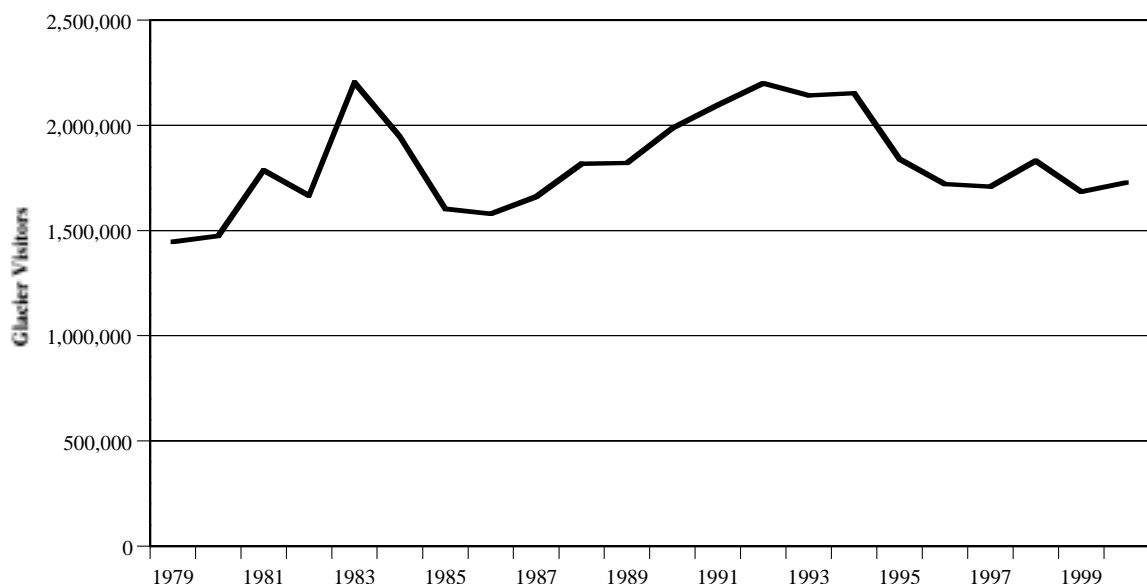
GNP visitor-related information relies primarily on data furnished by the NPS and by the Going-to-the-Sun Road *Socioeconomic Study* (WIS 2001b) and the Going-to-the-Sun Road *Transportation and Visitor Use Study* (WIS 2001c). One component of these studies was a survey of GNP visitors conducted in late August and early September 2000 (WIS 2001b). The results of this survey are an integral component of the socioeconomic analysis, as they provide valuable information on visitor background expenditures and experiences at the Park.

Visitation Level and Trends

This section discusses levels of visitation and their trends, including variation annually, seasonally, and weekly.

Annual Visitation. During the past 21 years, the annual number of visitors to GNP has ranged between a low of 1.4 million visitors in 1979 to highs of 2.2 million visitors in 1983 and 1992 (Figure 9). Visitation has fallen from the high levels of the early 1990s, and from 1995 to 2000, annual visitation has remained around 1.7 million visitors.

Figure 9. Visitors to Glacier National Park (1979-2000).



Over this same period, total national park visitation across the United States has grown steadily, from 47.5 million in 1979 to nearly 65 million in 1999, representing an average annual growth rate of 1.5 percent. Fluctuation of annual visitation levels for the entire national parks system is less volatile than for any particular park, because these totals represent parks in a variety of geographic locations and environmental settings and are not as vulnerable to the impacts of localized events such as fires, weather or flooding.

Visitation to national parks are subject to substantial annual variation. A comparison with visitors at Yellowstone National Park (YNP) from the mid-1980s through the mid-1990s indicates growth in visitation at the two parks was relatively similar. However, significant flooding problems at GNP in 1995 resulted in diminished visitation, which continued through the remainder of the decade. Similarly, concerns over forest fires were one cause

of a 10 percent drop in visitors at YNP between 1999 and 2000.

Seasonal Visitation. In addition to annual variation, there is a great deal of seasonality in visitation at GNP. Between 1995 and 1999, the average monthly visitation at GNP in July and August was greater than 500,000. These summer months are clearly the busiest periods at the Park, with nearly 60 percent of visitation occurring in July and August, and another 28 percent of visitors arriving during June and September (Figure 10). The remaining months of the year, from October through May, account for 12 percent of GNP visitors.

Weekly Visitation. As shown in Figure 11, there is relatively small variation in the number of daily visitors who enter the Park throughout the course of the week.

Figure 10. Monthly Visitors to Glacier National Park (1995-1999).

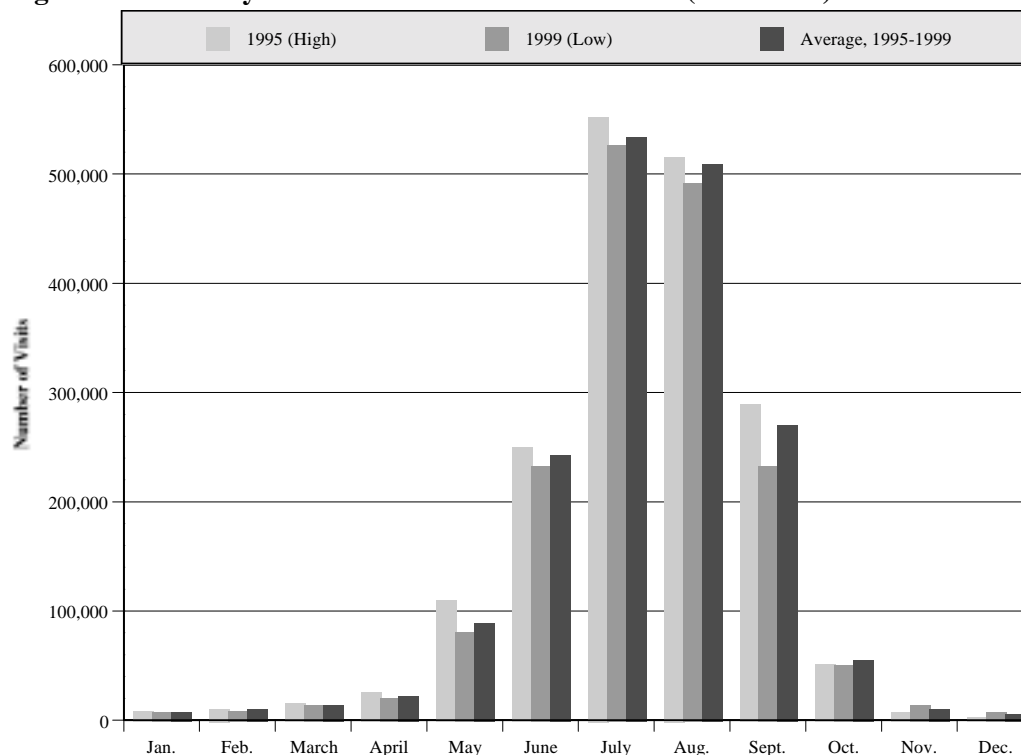
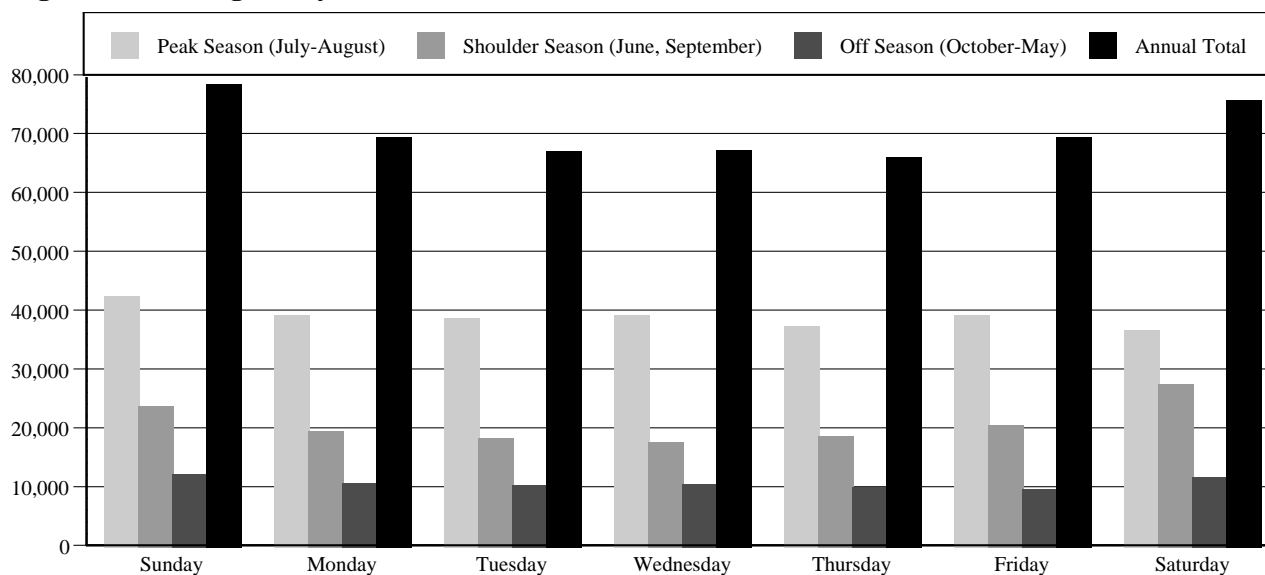


Figure 11. Average Daily Visitation Levels at Glacier National Park (2001).



The highest traffic occurs during the weekend, when approximately 31 percent of visitors enter the Park. However, mid-week visitation is only slightly lower per day. Monday through Friday account for roughly 69 percent of Park visitation. This trend is likely the result of Glacier's relative geographical isolation, out of proximity to major metropolitan population bases that could generate high levels of weekend visitation.

Visitor Use Patterns and Experience

This section addresses different elements of the GNP visitor experience, including the recreational activities that visitors participate in, such as driving the Going-to-the-Sun Road and visiting many other Park areas, as well as the duration of trips, where visitors stay, how visitors travel to GNP and their expenditures during their visits.

Visitor Activities. Visitors to GNP engage in a variety of recreational activities during their trips to the Park (Table 8). The most popular component of a visit to Glacier is sightseeing, which 97 percent of visitors do. Similarly, nearly nine in ten Glacier visitors participate in wildlife viewing and photography. More than half of all visitors do some sort of day hiking. A much smaller share of visitors participates in fishing, bicycling or backcountry camping. These more physically rigorous and time-consuming activities appeal to a narrower range of Glacier visitors.

Use of Going-to-the-Sun Road. The Going-to-the-Sun Road is one of the main attractions of GNP and an essential component of the visitor experience. In addition to providing unparalleled vistas for its travelers, it is the only route by which visitors can cross Glacier in their vehicles. The importance of the Going-to-the-Sun Road is indicated by the popularity of the sites to which it provides access.

Table 8. Proportion of visitor groups participating in each activity.

Visitor Activities	Percent of Visitors
Sightseeing	97%
Photography	89%
Wildlife Viewing	87%
Visit Visitor Centers and Museums	72%
Day hike	53%
Shop	51%
Picnic	45%
Camp in Developed Campground	32%
Attend Ranger-Led Program	22%
Boat	19%
Fish	13%
Bicycle	8%
Horseback Ride	7%
Overnight Backcountry Camp	3%
Other	11%

Source: GNP 1991

The areas along the Road receive the highest number of visitors and are often the focal point for a visit to GNP (Table 9 and Figure 12).

The most frequently visited destination along the Going-to-the-Sun Road is the Logan Pass area, where 76 percent of all visitors stopped during their trip to Glacier, 90 percent of which were out-of-state visitors. In addition to Logan Pass, there are a number of other popular sites along the Road. Among those are Lake Mc Donald, where 63 percent of visitors stopped, and the St. Mary Visitor Center, on Glacier's eastern side, which was visited by 41 percent of visitors. Many of these visits to areas along the Going-to-the-Sun Road are fairly short. A large share of visitors stops for more than an hour at only two sites, Avalanche and Logan Pass.

Table 9. Time spent in specific areas along the Road.

Area	Percent of Respondents Who Stopped	Most Frequent Response for Duration of Stop
Apgar	48%	15 – 30 minutes
Lake McDonald	63%	15 – 30 minutes
Avalanche	40%	1 – 4 hours
McDonald Creek/Overlook	29%	< 15 minutes
West Side Tunnel	26%	< 15 minutes
The Loop	35%	< 15 minutes
Big Bend	18%	< 15 minutes
Oberlin Bend	12%	< 15 minutes
Logan Pass	76%	1 – 4 hours
Siyeh Bend	21%	< 15 minutes
Jackson Glacier Overlook	36%	< 15 minutes
Sunrift Gorge	29%	< 15 minutes
Sun Point	29%	< 15 minutes
Rising Sun	32%	< 15 minutes
St. Mary Visitor Center	41%	15 – 30 minutes

Source: WIS 2001c.

Table 10. Days spent in the Glacier National Park area by Park visitors.

Number of Days	Percent
1	34%
2	20%
3	14%
4	8%
5	8%
6	17%

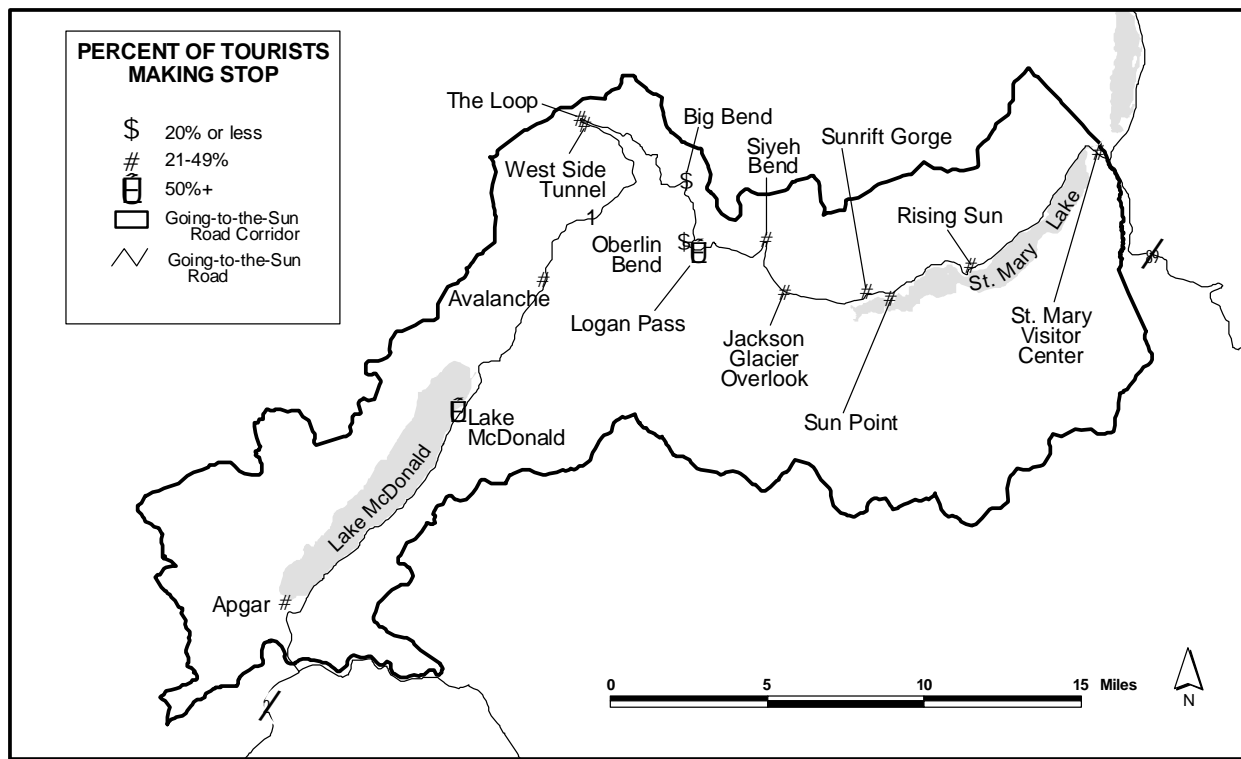
Source: WIS 2001c.

Visits to Other Park Areas. Glacier visitors explore a number of different areas in addition to those Park attractions located along the Going-to-the-Sun Road. The Many Glacier/Swiftcurrent Area, located to the northeast of Logan Pass and accessed by the Many Glacier Road from US 89, is visited by 39 percent of Glacier visitors, while one in four visitors ventures to Canada to stop at Waterton Lakes Park. Because these areas are dead-end destinations, rather than stops along the Park's main thoroughfare, these visits require additional driving time. Therefore, the visitors who are attracted to them typically spend more time there once they have arrived. Other destinations frequented by visitors in the Park include Two Medicine, Polebridge/ North Fork, Chief Mountain, and Camas Road. Table B-1 in Appendix B includes a summary of visitor use in GNP besides the Going-to-the-Sun Road corridor.

Duration of Trip. Over 50 percent of GNP visitors spend less than 2 days in the Park (Table 10). For in-state Glacier visitors, the average stay in the Park vicinity is 2 days and 2 nights, while non-Montanans visit the Glacier area for an average of 4 days and nights.

In addition to time spent in the GNP area, many visitors also travel to other parts of the state. On average, Canadian visitors to Glacier spend one additional day in Montana, while other out-of-state visitors typically travel in Montana for another four days.

Figure 12. Percent of Tourists Making Stops.



Travel Routes. While there are many routes that visitors to GNP may take to arrive or depart from the Park, the majority of visitors use either US 2 or US 89 (Figure 1). These two roads account for more than 80 percent of all trips to and from the Glacier area.

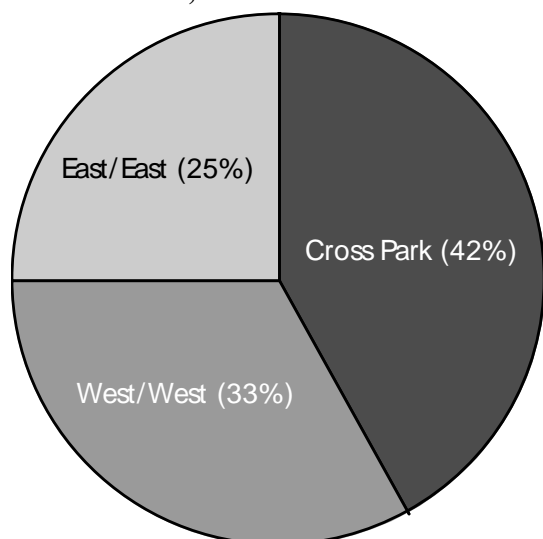
Depending on the route traveled, visitors to Glacier may travel through one or all of the counties in the United States portion of the study area. Visitors who travel to, or from, the west side of the Park on US 2 travel through Flathead County in route. US 2 on the east side of the Park takes a visitor through Glacier County. Travel on US 93, north of Glacier, brings visitors through Flathead County, while south of the Park, US 93 and MT 83 cross both Flathead and Lake counties. On the southeast side of GNP, US 89 travels through Glacier County.

Overall, the largest portion of visitors to GNP (42 percent) choose to enter the Park from one direction and exit the Park in the other direction, either moving from west to east or vice versa. The second largest share of travelers (33 percent) both enter and exit on the west side. Figure 13 illustrates the relative frequency of the three combinations of entry and exit travel route combinations for GNP visitors.

The routes that visitors travel to and from the Park have significant implications for the distribution of visitor expenditures and local economic impacts.

Visitor Origins. GNP is a destination for travelers from many parts of the world. Visitors come from throughout North America and overseas to experience its unparalleled natural beauty and take advantage of its recreational amenities. For this analysis, visitor origins were placed in four

Figure 13. Travel Routes To/From Glacier National Park, 2000.



Source: BBC 2002.

categories based on responses to the 2000 visitor survey. The vast majority (72.8 percent) of visitors to Glacier are from states other than Montana. The remaining share of visitors is comprised of Canadians, locals from Flathead, Lake or Glacier counties or non-local Montanans. Canadian visitors account for 6.8 percent of Glacier visitation, while local Montanans are 9.2 percent and non-local Montanans make up the remaining 11.2 percent. While there are non-Canadian foreign visitors to GNP, the totals are relatively insignificant.

Visitor Spending. The 2000 visitor survey asked respondents to estimate their group's average daily expenditure on various goods and services during their visit to the Glacier area (WIS 2001b). The average group spent nearly \$200 per day, though there is a great deal of variation among visitors depending on their lodging choices. Lodging and/or camping, along with meals and drinks at bars and restaurants, account for the largest share of total visitor expenditures. Out-of-state visitor groups spend the largest amount, while local Montanans

spend much less. Average daily expenditures by Canadian visitors ranged from about \$47 to \$256 per day depending on their place of lodging. Additional information on average daily expenditures is included in Appendix B, Tables B-2 and B-3.

Based on responses to the 2000 visitor survey on travel routes to and from the Glacier Area, and interviews with local representatives, estimates were developed for expenditures that took place in different market areas within the larger study area (Table 11). In 2000, total expenditures by GNP visitors were an estimated \$113 million, distributed between three Montana counties and southwestern Alberta. The largest share of total visitor expenditures in the study area took place in Flathead County followed by Glacier County, southwest Alberta, and Lake County (BBC 2002).

Contribution of GNP Visitors to Local Economies. The estimated \$113 million in annual spending (year 2000) by visitors to GNP provides an important contribution to local economies within the study area. For example, the estimated \$35 million in annual spending of GNP visitors on lodging and camping in United States portions of the study area, depicted in Table 11, represents a substantial portion of all annual expenditures on lodging in the three-county area.

Using the IMPLAN input/output model (described in more detail in Chapter 4 and Appendix B), the direct and secondary output (sales) and employment within the study area that is supported by GNP visitor spending was estimated (BBC 2002). Direct employment and sales supported by GNP visitors reflects the "first round" effects of visitor purchases. Secondary employment and sales supported by GNP visitors reflects "multiplier effects," or the economic activity that is supported by goods and services purchases of businesses serving tourists, as well as

Table 11. Baseline GNP visitor expenditures by category and county (year 2000).

Expenditures	Montana Counties			SW Alberta	Regional
	Flathead	Glacier	Lake	CD-3	Total
Groceries	\$4,029,000	\$2,637,000	\$781,000	\$1,570,000	\$9,017,000
Restaurant/Bar	\$10,000,000	\$6,545,000	\$1,939,000	\$3,898,000	\$22,382,000
Gas/Auto	\$5,769,000	\$3,776,000	\$1,118,000	\$2,248,000	\$12,911,000
Lodging/Camping	\$19,046,000	\$12,466,000	\$3,692,000	\$7,423,000	\$42,627,000
Recreation	\$2,573,000	\$1,684,000	\$499,000	\$1,003,000	\$5,759,000
Gifts	\$6,093,000	\$3,988,000	\$1,181,000	\$2,375,000	\$13,637,000
Other [†]	\$2,990,000	\$1,957,000	\$580,000	\$1,166,000	\$6,693,000
Total	\$50,501,000	\$33,052,000	\$9,790,000	\$19,683,000	\$113,026,000

[†]Excluding airfare.

Source: BBC 2002.

the activity supported by the purchases of the employees who work in tourism related businesses.

Spending by GNP visitors directly supported an estimated \$111 million in annual output (sales) in 2001 across Montana and Alberta (Table 12). The bulk of these sales occurred within the three-county local impact area in Montana and southwest Alberta. These totals differ from the regional totals presented in Table 11 because spending by local residents within the study area who visited the Park was excluded from this analysis, and because Table 12 is expressed in 2001 dollars. Secondary, or “multiplier” effects added another \$61.7 million to direct sales to GNP visitors, implying a total level of sales or output related to GNP visitation of over \$172 million in 2001 (BBC 2002).

The annual output (sales) figures can be translated into numbers of jobs based upon the IMPLAN model (IMPLAN 2002). Visitation to GNP in 2001 is estimated to have directly supported over 2,500 jobs in Montana and Alberta and indirectly supported another 900 jobs (Table 13).

Table 12. Estimated direct and secondary output supported by GNP visitation (year 2001).

Area	Direct Output	Secondary Output [†]	Total Output
Montana			
Flathead County	\$49,681,000	\$16,811,000	\$66,492,000
Glacier County	\$32,250,000	\$5,514,000	\$37,764,000
Lake County	\$9,514,000	\$2,754,000	\$104,256,000
Study Area Total [‡]	\$91,814,000	\$31,471,000	\$123,285,000
Statewide	\$91,825,000	\$34,307,000	\$126,132,000
Alberta	\$19,074,000	\$27,448,000	\$46,522,000
Total	\$110,899,000	\$61,755,000	\$172,654,000

[†]Secondary output totals include induced effects (economic activity supported by direct employee spending) and indirect effects (economic activity supported by goods and services purchases of directly affected industries).

Statewide totals are derived by defining the state of Montana as the area of impact within IMPLAN.

[‡]Montana study area totals are larger than the sum of the three individual Montana county totals because of cross-county trade flows captured in modeling the region as a whole, but not captured in the individual county analyses.

Source: BBC 2002.

Table 13. Estimated direct and secondary employment supported by GNP visitation (year 2001).

Area	Direct Jobs	Secondary Jobs [†]	Total Jobs
Montana			
Flathead County	1,135	265	1,400
Glacier County	660	90	750
Lake County	235	45	280
Study Area [‡]	2,100	505	2,605
Statewide	2,180	525	2,705
Alberta	330	375	705
Total	2,510	900	3,410

[†]Secondary jobs include induced effects (jobs supported by direct employee spending) and indirect effects (jobs supported by goods and services purchases of directly affected industries).

[‡]Montana study area totals are larger than the sum of the three individual Montana county totals because of cross-county trade flows captured in the regional modeling, but not captured in the individual county analyses.

Source: BBC 2002.

Park Operations

Another facet of GNP's contribution to local economies is the operation of the Park itself. NPS operations at GNP includes seasonal and full-time employees with an annual budget that includes \$10 million in base funding for operations and about \$18 million in special project funds for 2002. Park concessionaires, particularly Glacier Park Inc. (GPI), which operates the major lodges within the Park and other facilities and services, also add to local employment and economic activity and may help to stabilize the local economy.

Park concessioner activity is reflected within the lodging sectors of the three Montana counties, captured in the IMPLAN model. A portion of the local economic activity resulting from NPS operations is also reflected in the model, as part of the recreation services sector. However, the

relatively unusual nature of these operations and the fact that a substantial portion of their funding is not directly linked to visitor expenditures implies that these activities may not be well represented by standardized economic models. The following is a summary of key aspects of current Park operations, from an economic standpoint.

Expenditures. The Park's 2002 appropriations total \$28 million, a 22 percent increase over 2001 appropriations of \$23 million. The primary reason for the increase was an addition of \$6.9 million in funds for construction projects, including the Apgar/Headquarters water system and hotel stabilization at Many Glacier. In addition to annual appropriations, the Park spent \$1.8 million in 2001 and \$2.5 million in 2002 in earned revenues, primarily consisting of recreation fee demonstration projects. These expenditures were supported by \$3.2 million in revenues in 2000 and \$3.1 million in revenues in 2001.

Of the \$28 million 2002 budget, only \$10.4 million (36 percent) consists of on-going Park operations, with other operating spending including the cost of collecting revenues (\$750,000), a new learning center to be established in 2002 (\$225,000), and expended revenues (\$2.5 million). All other spending is composed of various one-time projects, including this EIS and a number of on-going construction efforts.

The majority of operating appropriations consists of employee salaries and benefits. In 2000, salaries and benefits made up 87 percent of all operating spending, with supplies and materials, services and travel constituting another 10 percent.

Employment. GNP's 2001-2002 budget reports 155 full-time positions, 25 of which were unfilled as of January 2002 (Table 14). These employees are organized into six operating divisions that report to the Superintendent's office: administration,

Table 14. National Park Service employees by division at Glacier National Park.

NPS Division	Total Positions	Vacant Positions	Filled Positions
Superintendent's Office	5	2	3
Administration	21	0	21
Interpretation	13	3	10
Resource Management	52	11	41
Facility Management	55	9	46
Project Management	6	0	6
Concessions Management	3	0	3
Total	155	25	130

Source: GNP 2002.

interpretation, resource management, facility management, project management, and concessions management. In addition to these full time positions, GNP employs approximately 390 seasonal workers each year.

Local and Regional Economy

The Montana portions of the study area cover Flathead, Glacier, and Lake counties and include large parts of two American Indian Reservations, the Flathead Reservation and the Blackfeet Reservation. The Alberta portion of the study area includes three

municipal districts, incorporated and unincorporated towns and villages, and two Native Reserves.

Information presented in this section without citation comes from the Going-to-the-Sun Road *Socioeconomic Study* (WIS 2001b). Other citations included in this text refer to new information gathered specifically to prepare this analysis.

Montana

Figure 14 depicts the Montana portion of the study area, which includes three counties of northwest Montana: Flathead, Glacier, and Lake counties. This section provides information on land ownership, economic conditions, employment, and other economic characteristics of the Montana portion of the study area.

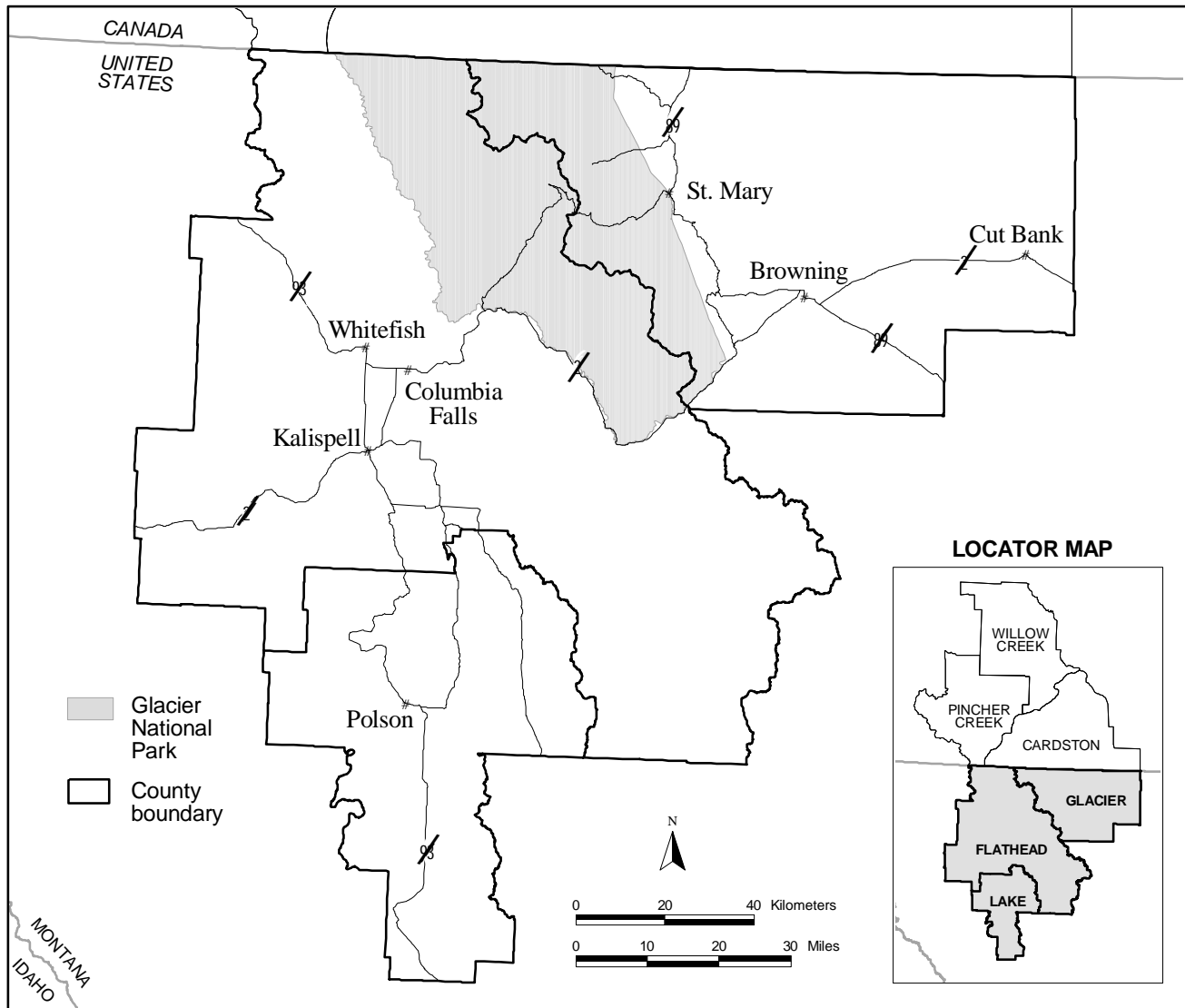
Land Ownership. A large share of the lands within the United States portion of the study area is not privately owned. In the three Montana counties, there are national parks, national forests, Bureau of Land Management (BLM) property, a wildlife refuge, and substantial portions of two large American Indian Reservations (Table 15).

Table 15. Montana portion of the study area land area and ownership.

Location	Ownership Percentage				
	Land Area in Square Miles	National Park	USFS/BLM	Reservation	Other
State of Montana	145,556	1%	26%	6%	67%
Flathead County	5,099	11%	53%	1%	35%
Glacier County	2,995	33%	2%	48%	18%
Lake County	1,494	0%	15%	37%	48%
Three-County Region	9,588	16%	31%	21%	32%

Source: WIS 2001c.

Figure 14. Montana Economic Study Area.



Economic Base and Employment. For its size, Flathead County has a diverse local economy anchored by tourism, forest products, and electric power generation. Emerging trends include technology, the arts, professional services, and businesses catering to second-home owners and retirees.

In Glacier County, almost half of the land area is within the Blackfeet Reservation. With Reservation residents comprising about 70 percent of the

county's population, Tribal agencies are a major source of jobs and income, bolstered by tourism and agriculture.

The Flathead Reservation comprises about 37 percent of the land area in Lake County. The remaining land includes large natural resource areas such as Flathead Lake, the National Bison Range, and the Bob Marshall Wilderness. Besides a strong visitor base, the Lake County economy relies on

timbering, manufacturing, and electric power generation.

Over 50 percent of total employment in Flathead, Glacier, and Lake counties is in the trade and services sectors. Construction jobs represent an above state average share of employment in Flathead County, reflecting rapid growth from 1990 to 1999. In Flathead County, the construction sector responds to other economic development activity within the county, including the county's emerging identity as a desirable second-home and retirement community. Only about 12 percent of the construction jobs in Flathead County are with heavy construction firms, and only about 3 percent are with highway, street and bridge construction firms (Census 2002).

Manufacturing jobs are 11 percent of total employment in Lake and Flathead counties, which is a relatively large share for small counties. Forest products firms are the largest source of manufacturing jobs in both counties. Job growth in tool and technology manufacturing grew quickly in Lake County between 1990 and 1999, but a major consumer product manufacturer experienced layoffs in 2000. Historically, aluminum processing also has been important in Flathead County. The Columbia Falls Aluminum plant cut back operations sharply in 2001, but is increasing production in 2002 to about 50 percent of capacity (Daily Inter Lake Newspaper 2002).

Glacier and Lake counties have large farm and agricultural services sectors, and of all three counties, Glacier has the most prominent government sector, at 22 percent of total employment. Table B-4 in Appendix B includes a profile of employment by key industry sector in Flathead, Glacier, and Lake counties and comparable data for Montana as a whole.

Total employment in the three counties grew to 66,346 full and part-time jobs in 1999 from 37,652 in 1980, an average annual rate of 3.0 percent compared to 1.8 percent for the State of Montana (Table 16). Almost all the job growth occurred in Flathead and Lake counties, which grew respectively at rates of 3.4 percent and 3.6 percent per year on average. Glacier County added only a few hundred jobs between 1990 and 1999, and the employment level in 1999 was still somewhat lower than in 1980.

Employment by industry in the three-county region has shifted over the past two decades from high- to relatively low-earning sectors of the economy. Based on data from 1999 (the most recent available), jobs in the services sector are now 32 percent of total employment, up from 22 percent in 1980, while retail jobs are 20 percent of total employment, up from 18 percent. Manufacturing jobs dropped to 10 percent of total employment in 1999 from 13 percent in 1980. The region's economy is now also less agricultural—farm employment was 4 percent of

Table 16. Total employment, 1980 to 1999, three-county study area, Montana.

Location	1980	1990	1999	Average Annual Rate, 1980 to 1999
State of Montana	394,012	436,574	552,276	1.8%
Flathead County	24,705	33,287	46,904	3.4%
Glacier County	6,095	5,286	5,929	-0.1%
Lake County	6,852	9,376	13,513	3.6%
Three-County Region	37,652	47,949	66,346	3.0%

Source: Bureau of Economic Analysis 2001.

total employment in 1999, compared to 7 percent in 1980. As the third largest source of jobs in the region, government lends some stability to the local economy. Table B-5 in Appendix B includes a breakdown of employment by industry for the Montana portion of the study area.

Transportation Construction Industry. Montana's transportation construction industry (including prime and subcontractors involved in highway, street, bridge, and tunnel construction) is relatively small, with reported employment in 1999 of 1,529 spread across 113 establishments, only eight of which employ more than 50 persons. Most of the places where Montana's transportation construction businesses are located are more than 2 hour's drive from GNP. There is, however, a construction firm in Kalispell that has been involved in previous Going-to-the-Sun Road work. Three metropolitan areas (Billings, Great Falls, and Missoula) and Gallatin County, which includes Bozeman, contain more than 70 percent of employment in the transportation construction industry and most of the larger establishments. Information on the distribution of transportation construction employment and businesses is included in Appendix B, Table B-6.

Tourism. GNP visitors are one of the most important components of tourism and the general economy in Flathead County. However, the county's visitor attractions also include the Big Mountain ski resort, and Whitefish, a resort community based on year-round recreation. GNP visitors influence, but do not appear to dominate the overall economy of the county. An indicator of this is that during two downward trends in GNP visitation in the past, the rate of job growth in Flathead County slowed but did not decline.

Within the study area, Glacier County is the most dependent on tourism stimulated by GNP. One of

the county's largest local employers is GPI, the lodging operator for the Park, and there are many small tourist businesses within the county. Park visitors and the ability of local businesses to capture tourist expenditures are driving local economic growth expectations.

In Lake County, many residents earn a living from tourism, including tourism generated by GNP. However, other major attractions—particularly Flathead Lake—contribute to the visitor economy. Visitor levels at GNP influence but do not appear to dominate the county's overall economy. Annual fluctuations in visits to GNP do not correspond closely with annual changes in population and employment in Lake County, but during two recent downturns in Park visitors in the mid 1980s and mid 1990s, the rate of employment growth in the county did slow down.

As a general indicator, both Flathead and Glacier counties generate greater bed tax revenue per capita than the statewide average (Table 17). Bed tax revenues in Lake County are misleading because the largest lodging establishment in the county is located on tribal land and does not collect bed taxes.

Table 17. Bed tax revenue per capita and revenue growth in the Montana study area.

Location	Bed Tax Revenue per Capita in 1999	Bed Tax Revenue Annual Growth rate Since 1990
Montana	\$12.00	6.5%
Flathead County	\$17.46	4.9%
Glacier County	\$30.25	6.4%
Lake County	\$3.00	5.6%

Source: BBC 2002.

Labor Force and Demographics. Tourist businesses employ many workers throughout the three-county region, but the range of other employment opportunities varies from county to county. In Flathead County, local residents find employment in a small concentration of manufacturing and professional services establishments, while in Lake County local residents work in timber production, power generation, manufacturing, and medical care. With fewer choices, Glacier County residents generally work at tourism-related or agricultural jobs.

Income. Total personal income has grown by almost 6 percent annually since 1980 in the study area, compared to 5 percent in Montana as a whole, but because of population growth, per capita personal income in the region grew more slowly (Table 18).

Per capita income in the three-county region grew by an annual average of 4.4 percent from 1980 to 1999 compared to an annual average of 4.6 percent for the State of Montana, and is now 92 percent of the Montana average, down from 96 percent of average in 1980. Income in Glacier County has lagged behind Flathead and Lake counties by a considerable margin (Table 19). Per capita income in Glacier County grew by an annual average of 2.5 percent from 1980 to 1999, and was 69 percent of the state average in 1999 — down from 3 percent above

Table 18. Per capita personal income, Montana and three-county study area.

Location	1990	1995	1999
Montana	\$9,143	\$15,524	\$21,997
Flathead County	\$9,348	\$15,862	\$22,265
Glacier County	\$9,462	\$11,162	\$15,205
Lake County	\$6,959	\$13,270	\$17,234
Three-Region County	\$8,815	\$14,695	\$20,295

Source: Bureau of Economic Analysis 2001.

Table 19. Total personal income, Montana and three-county study area.

Location	1980	1990	1999
	(thousands of dollars)		
Montana	\$7,211,462	\$12,416,204	\$19,418,790
Flathead County	\$486,788	\$944,304	\$1,620,301
Glacier County	\$100,286	\$135,496	\$191,629
Lake County	\$132,915	\$279,289	\$446,093
Three-County Region	\$719,989	\$1,359,089	\$2,258,023

Source: Bureau of Economic Analysis 2001.

average in 1980. The sharp decline reflects the contraction of the local oil and gas industry.

Unemployment. The job base in these counties prompts people to commute into the primary study area on a regular or seasonal basis. However, unemployment rates among local residents remain higher than in the State of Montana as a whole, especially in Glacier County because of its dependence on seasonal jobs and high unemployment among residents of the Blackfeet Reservation. Table 20 compares unemployment rates at the state, county, and regional level for selected years since 1990.

Labor Force Availability and Employment Seasonality. Seasonality, availability, and other characteristics of the local labor force affect the

Table 20. Unemployment rates, Montana and three-county study area.

Location	1990	1995	1999
Montana	6.0%	5.9%	5.2%
Flathead County	7.6%	8.1%	7.1%
Glacier County	11.8%	14.7%	14.3%
Lake County	8.2%	8.0%	6.3%
Three-Region County	8.2%	8.8%	7.6%

Source: LAUS 2001.

ability of firms and projects to hire locally within the Montana study area. A relatively high proportion of Glacier County's labor force was unemployed during 2000, and, based on 1990 data, relatively few Glacier County residents commuted to jobs in other counties, while the county attracted a relatively small proportion of new residents. A large proportion of Lake County workers commuted to jobs in other counties, as compared to the other counties in the study area and in Montana as a whole.

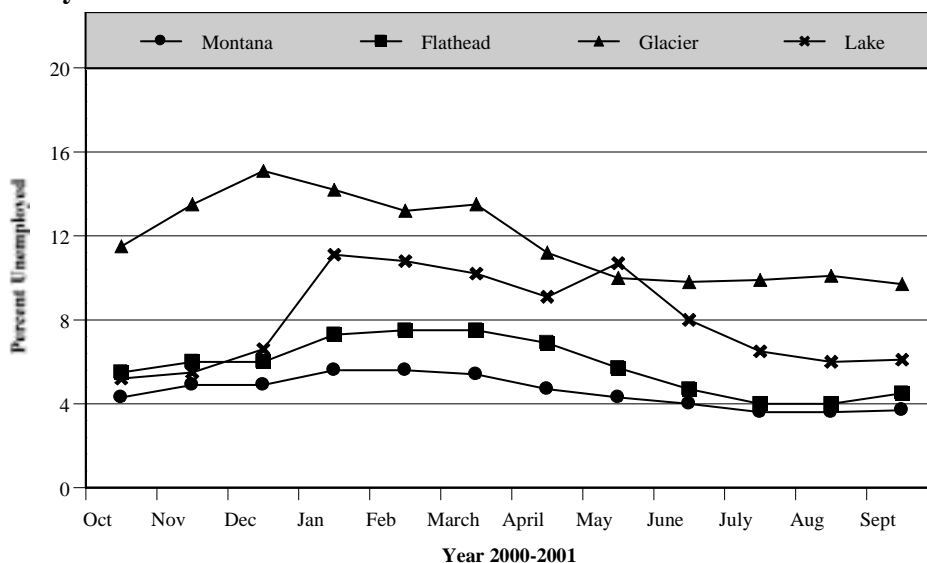
Employment within the study area fluctuates seasonally, as it does to a much lesser extent in Montana as a whole. In all three counties, the unemployment rate is highest in the winter and lowest in the summer, mainly reflecting patterns of activity in tourism and agriculture. A diversity of employers tends to lessen seasonal differences in unemployment in Flathead and Lake counties, compared to Glacier County. Using data from 12 recent months, Figure 15 illustrates the seasonality of unemployment in the counties of the study area compared to Montana as a whole.

Within the three-county study area, local residents filled about 95 percent of local jobs in 1990, according to the most recent commuting data available. Missoula County was the largest single-county source of in-commuters to the study area in 1990, with most going to Lake County where Missoula County residents were about 2 percent of the work force located in Lake County. A significant proportion (16 percent) of Lake County's working residents held jobs

outside the county, with more than half of Lake County's out-commuters traveling to work in Flathead County (BBC 2002).

Demographics. The three-county study area is mainly rural, and although there are many population centers, most are quite small. Flathead County contains some of the population centers in the study area: the city of Kalispell (14,223), unincorporated Evergreen near Kalispell (6,215), the city of Whitefish (5,032), and the city of Columbia Falls (3,645) (Census 2000a). There are 15 other small population centers in Flathead County. Glacier County has seven population centers, the largest of which are the city of Cut Bank (3,105) and the town of Browning (1,065), unincorporated North Browning (2,200), and unincorporated South Browning (1,677). Among the 18 population centers in Lake County, the largest are Polson (4,041), the city of Ronan (1,812), and the town of St. Ignatius (788).

Figure 15. Seasonality in Monthly Unemployment Rates in the Montana Study Area.



Source: LAUS 2001.

Since 1980, the population of the primary study area has consistently grown faster than the State of Montana as a whole. Regional growth is mostly due to high growth rates in Flathead and Lake counties since 1990, where there has been a surge of recreation development and second-home ownership. In contrast, the growth rate in Glacier County since 1990 has fallen to below that of the state and region. The 2000 Census counted 114,225 people in the three counties and placed Flathead County's population at 74,471, or 65 percent of the total (Table 21).

The presence of the Blackfeet and Flathead reservations influences the demographics of the study area. The projections indicate that the state and all three counties will grow considerably slower in the future, with Glacier County expected to grow hardly at all. As a whole, the projections indicate that the three-county region would grow at the rate of about 1.5 percent per year from 2000 to 2025 (Table 22). Projected populations for the year 2025 within the three-county study area published by the State of Montana are 113,160 for Flathead County; 13,420 for Glacier County; and 38,930 for Lake County.

Demographic data indicates that 19 percent of the population in the three-county study area were below the poverty level in 1998 (Census 2000b). Persons in poverty are greatest in Glacier County (36 percent), followed by Lake County (22 percent), and Flathead County (15 percent). Additional information on demographic characteristics for the

Table 21. Study area population, Montana and three-county study area.

Location	1970	1980	1990	2000
State of Montana	694,409	788,752	799,055	902,195
Flathead County	39,460	52,076	59,218	74,471
Glacier County	10,783	10,599	12,139	13,247
Lake County	14,445	19,101	21,046	26,507
Three-County Region	64,688	81,776	92,403	114,225

Source: Census 2000a.

three-county study area and Montana is included in Appendix B, Table B-7.

Flathead Reservation. Lake County contains more than 600 square miles (1,555 square kilometers) of the Flathead Reservation and the Reservation's important population centers. About 44 square miles (114 square kilometers) of the Reservation are in Flathead County, and the rest of the Reservation is in Sanders County. The Flathead Reservation contains most of Flathead Lake, the Mission Valley, the National Bison Range, and the Mission Tribal Wilderness, as well as significant commercial timber resources.

The population within the 1.2-million acre (486,000 hectares) Flathead Reservation is 26,172, having grown at about 2.1 percent per year since 1990. Only about 27 percent of the population on the

Table 22. Historical and projected population growth rates for the Montana study area.

Growth Rate	Montana	Flathead	Glacier	Lake
Annual rate of growth 1990 to 1999	1.2%	2.3%	0.9%	2.3%
Projected annual rate of growth 2000 to 2025	1.0%	1.7%	0.2%	1.5%

Note: Projections data available from Census and Economic Information Center, Montana Department of Commerce
Source: NPA 2000; BBC 2002.

Reservation consists of American Indians. The Reservation population is relatively young, with only 5.6 percent 65 years old or older compared to 13.3 percent for the state and 15.7 percent for Lake County (Census 1990, 2000a).

Membership in the Confederated Salish and Kootenai Tribes of the Flathead Nation is about 6,900 (Montana Dept. of Labor and Industry 2002). Tribal headquarters are in unincorporated Pablo in Lake County (population of 1,814) (Census 2000a). Three other larger communities of Lake County—Polson, Ronan, and St. Ignatius—are on the Reservation or within its boundaries.

Lake County's largest employer is the tribally owned and operated Best Western KwaTaqNuk Resort and casino on the shore of Flathead Lake in Polson. Other large employers are the Tribal government and Salish and Kootenai College, a tribally operated institution. State estimates show the unemployment rate on the Flathead reservation is somewhat lower than the Lake County rate, but the Bureau of Indian Affairs reports a much higher rate, about 44 percent, probably because of a different definition of the labor force (U.S. Bureau of Indian Affairs 1999). Reservation per capita income in 1989, the last year for which data are available, was about 81 percent of the rate for Montana as a whole (Census 1990). The share of persons below the poverty line in 1989 was 23 percent on the Reservation, compared to 16 percent for the state as a whole.

Other involvement in economic development by the Tribes includes direct investment and business development assistance, including the direct financial backing of another of Lake County's major employers, S & K Technologies, a defense contractor. Chambers of commerce in Polson, St. Ignatius, and Ronan promote the attractions and tourist services of the Mission Valley.

Blackfeet Reservation. The Blackfeet Tribe (Tribe) ceded land east of the Continental Divide to the United States government in an 1896 treaty. The current Blackfeet Reservation contains about 1.9 million acres. Most of the land area of the Reservation is within Glacier County and the rest is in Pondera County, Montana. The Tribal headquarters are in Browning in Glacier County. The communities of East Glacier and St. Mary, which are gateways to GNP, are on the Reservation.

The population of the Blackfeet Reservation was 10,100 in 2000, having grown at about 1.7 percent per year since 1990. About 84 percent of the population on the Reservation consists of American Indians. The Reservation population is young, with 43 percent under 18 years old compared to about 28 percent for the State of Montana as a whole (Census 1990, 2000a). The Tribe has about 15,300 enrolled members (Montana Dept. of Labor and Industry 2002).

Blackfeet Reservation farmers and ranchers produce a variety of crops and large numbers of livestock on Reservation land, about a third of which is rangeland. Reservation-based agencies such as the Tribe, Blackfeet Housing Authority, U.S. Indian Health Service, and U.S. Bureau of Indian Affairs are among the largest employers in Glacier County. Many Reservation residents are active as forest firefighters. The Reservation also contains the headquarters of GPI, the Park's lodging concessionaire, and many motels, campgrounds, restaurants, and stores whose market is mainly GNP tourists.

The unemployment rate on the Reservation is much higher than state and county levels: about 20 percent in 2000 according to the Montana Department of Labor and Industry (LAUS 2001). However, unemployment on the Reservation may be as high as 70 percent (Baucus 2001). Reservation per capita

income in 1989, the last year for which data are available, was about 50 percent of the rate for Montana as a whole. The share of persons below the poverty line in 1989 was 47 percent on the Reservation, compared to 16 percent for the state as a whole (Census 1990).

The Blackfeet Nation promotes economic development by sponsoring its own business development agency, and the Tribe delivers technical assistance to businesses through Blackfeet Community College. Still, local business ventures have experienced distress, including the Blackfeet Writing Company, a manufacturer with 80 percent Tribal ownership that recently reduced its employment levels sharply.

Economic Development and Tourism Promotion.

Tourism planning and promotion, as well as other local economic development activities, are the responsibility of a wide range of organizations located in many communities throughout the study area (Table 23). The range of organizations in Flathead County reflects its broad-based visitor orientation while the influence of American Indian Tribal interests is prominent in Glacier and Lake counties.

Housing. Census data for the year 2000 provides information about the total numbers and general types of housing in Montana portions of the study area. Although there are variations among them, Flathead, Lake, and Glacier counties demonstrate similar characteristics. All have relatively even splits between owner occupied and other units. Flathead County has the largest share of owner occupied units, with 62 percent, while 51 and 53 percent of the units in Glacier and Lake counties are owner occupied. Flathead also has the largest number of units overall, with 34,773, followed by Lake with 13,605, and Glacier with 5,243. The most significant factor shared by the three counties is the

large number of seasonal units, constituting 79 percent of vacant units in Lake County and 69 and 41 percent in Flathead and Glacier counties, respectively.

The 2000 Census reported 9,535 vacant units in the three counties. However, 70 percent of these are seasonal units and are unlikely to be available for workforce housing. Excluding seasonal units, there were 1,600 vacant owner and renter units reported in the 2000 Census—2.9 percent of all units in the three counties. Of these units, 1,027 were classified as renter units and would be more likely to be affordable for additional workers. Housing units by county are included in Table B-8 of Appendix B.

Availability of housing may be more limited than it appears because large numbers of the vacant units are located on reservation land. On the Blackfeet

Table 23. Organizations involved in economic development and tourism promotion in the Montana study area.

County	Organizations
Flathead	Bigfork Chamber of Commerce Columbia Falls Chamber of Commerce Flathead Convention and Visitors Bureau Flathead County Port Authority Glacier County Regional Tourism Commission Kalispell Chamber of Commerce Lakeside-Somers Chamber of Commerce Whitefish Chamber of Commerce Whitefish Convention and Visitors Bureau
Glacier	Cut Bank Chamber of Commerce Glacier Action and Involvement Now (GAIN) of Cut Bank Blackfeet Tribal Council East Glacier Chamber of Commerce
Lake	Salish and Kootenai Tribal Council Port Polson Chamber of Commerce St. Ignatius Chamber of Commerce Ronan Chamber of Commerce

Source: WIS 2001b.

Reservation for example, most housing is HUD units that cannot be rented out legally. If reservation and seasonal units are excluded from vacancy calculations, about 2,000 of 9,500 vacant units in the three counties are available (Table 24).

Construction of an additional 500 units is reported as having been started between 1997 and 1999, which may have provided additional vacant units. However, no information is available about demolition over that time period, so no firm conclusions can be drawn about more recent changes in the housing market.

Community Facilities and Services. A wide array of jurisdictions and agencies provide public services in Montana including: the State of Montana; Flathead, Glacier and Lake counties; numerous cities and towns (Kalispell, Whitefish Columbia Falls, Browning, Cut Bank and others); and a variety of local water, wastewater, and fire districts. The following is a brief description of service provision in a number of areas, followed by a more in-depth discussion of the public revenues and expenditures of a number of major entities.

Public Safety. Public safety services are provided at the federal, state, provincial, county, and municipal levels. For the most part, however, localities take responsibility for public safety. In Montana, these services are delivered by the three counties in unincorporated areas and by municipalities in incorporated areas. Because the study area is largely unincorporated, the counties provide most public safety services.

Water and Wastewater. Unlike public safety, water and sewer services in Montana are not typically provided by the county. Instead, utilities managed by cities, towns, and local improvement districts provide this service.

Table 24. Non-seasonal/reservation vacant units.

Housing Units	Flathead County	Glacier County	Lake County
Total Vacant Units	5,183	939	3,413
Seasonal Units	3,570	268	2,690
Units on Reservation Land	—	333	700
Available Vacant Units	1,613	338	23

Source: Census 2000a.

Fire protection. Fire protection is similar to water and sewer service provision, with municipalities and local districts providing the service.

Schools. School services in the Montana study area are provided by a number of districts and are overseen by superintendents in each county. Flathead County serves over 11,000 students in 32 elementary and middle schools and four high schools. Glacier County has a student population of 3,000 and Lake County has a student population of 4,600.

The school districts adjacent to GNP are located in Flathead County and Glacier County. In Flathead County, the Columbia Falls, Kalispell, West Glacier and Whitefish districts constitute 15 elementary schools with 5,700 students and three high schools with 1,600 students. Kalispell school trustees are evaluating the construction of one or more new high schools to alleviate overcrowding and serve expected growth (The Daily Inter Lake 2002). On the east side of GNP, the closest districts are Browning and East Glacier, with 1,400 students in eight primary schools and 548 high school students in one school.

Public Revenues and Expenditures. One method of gauging the available capacity of the various public service providers is through an examination of their financial condition. The following

discussion summarizes the finances of the three-county study area and Montana.

The budgets of the three counties vary in size, from Glacier at \$13.8 million to Lake at \$18.2 million and Flathead at over \$60 million. These variations are due to a diversity of revenue bases and service demands. The budget for the State of Montana exceeds \$1.8 billion for general fund services alone. The finances of each of the three counties are subject to fluctuations in taxable valuations and related dependence on property tax revenues as well as a lack of sales tax revenues.

Flathead County. Flathead County is the largest of the three counties with a 2001 budget that was over four times the budget of Glacier County, totaling \$61.2 million. Primary expenditures included government activities, various capital projects, provision of solid waste services, road and bridge funds, and sheriff expenses.

Approximately 50 percent of these services are funded through property taxes (\$31 million), while the balance (\$30 million) are supported by fees, grants, and other revenues. The general fund is primarily supported by property taxes (24 percent of revenues) and state transfers (26 percent). Primary funding for the road and bridge and sheriff funds comes from the same two sources, with property taxes and intergovernmental transfers constituting essentially all revenues.

Flathead County's taxable property value has decreased from \$137 million in 1997-1998 to \$130 million in 2001-2002. As in Glacier and Lake counties, this is due to changes in the state's property classification system. In addition, like Glacier and Lake counties, Flathead County does not have any general obligation debt.

Glacier County. Glacier County's 2001 budget was reported at \$13.8 million including \$7.4 million in appropriations for the county hospital.

While most of the county's general fund, road fund, bridge fund and public safety fund expenditures are supported by taxes, hospital expenditures are generally reimbursed. The largest share of general fund revenues (43 percent) consists of property taxes, with other large revenue sources including intergovernmental funds (state and federal transfers making up 24 percent of revenues) and interest earnings (10 percent). Property taxes also constitute the largest share of road fund and public safety revenues, with various intergovernmental transfers providing substantial additional support to those funds.

Glacier County's taxable valuation has declined slightly over the past 4 years, from \$22.4 million in 1997-98 to \$17.4 million in 2001-2002. The decline is primarily due to state property re-classifications, which are designed to phase out taxation of personal property. Based on this level of taxable valuation, the county generates \$17,400 with every mil of property tax that is levied. Glacier County does not have any general obligation debt to support with property taxes or other revenues.

Lake County. Lake County's budget in 2001 totaled \$18.2 million. Major expenditure items in Lake County included general fund services, public safety and district court, various solid waste functions, improvements to the Ronan airport, and road and bridge services.

Together, these services make up two-thirds of Lake County spending. The majority of the budget is funded by property taxes and intergovernmental revenues. Primary general fund support comes from property taxes and intergovernmental transfers, which constitute 29 and 26 percent of respective

revenues. Property taxes and intergovernmental revenues also make up 90 percent of road and bridge fund revenues and 56 percent of sheriff revenues.

Like Glacier County, Lake County's taxable valuation decreased from \$47 million in 1997-98 to \$45 million in 2001-2002 due to state re-classifications. Lake County does not have any general obligation debt to support with property tax or other revenues.

State of Montana. The State of Montana's 2000 financial statements reveal general fund revenues of \$1.1 billion and special revenue fund revenues of \$1.8 billion. Over 82 percent of state revenues come from taxes and federal transfers, with taxes constituting a majority of general fund revenues (\$822 million) and federal funds contributing a majority of special revenue funds (\$1.1 billion). State-generated tax revenues consist primarily of income, property and fuel taxes, with smaller contributions from natural resources and other taxes.

A relatively minor revenue source is the 4 percent accommodations (bed) tax imposed on users of overnight lodging facilities. Total receipts from this tax totaled \$11 million in 2000, with two-thirds distributed to the state Department of Commerce, 10 percent to other state agencies and 22.5 percent to various regional tourism corporations.

While the state's revenues primarily come from two sources, taxes and federal transfers, expenditures are distributed more evenly, with 87 percent spread among five areas: general government, public safety/corrections, transportation, health/social services, and education/cultural. Of these expenditures, three (general government, public safety/corrections, and education/cultural) are primarily state funded and the other two

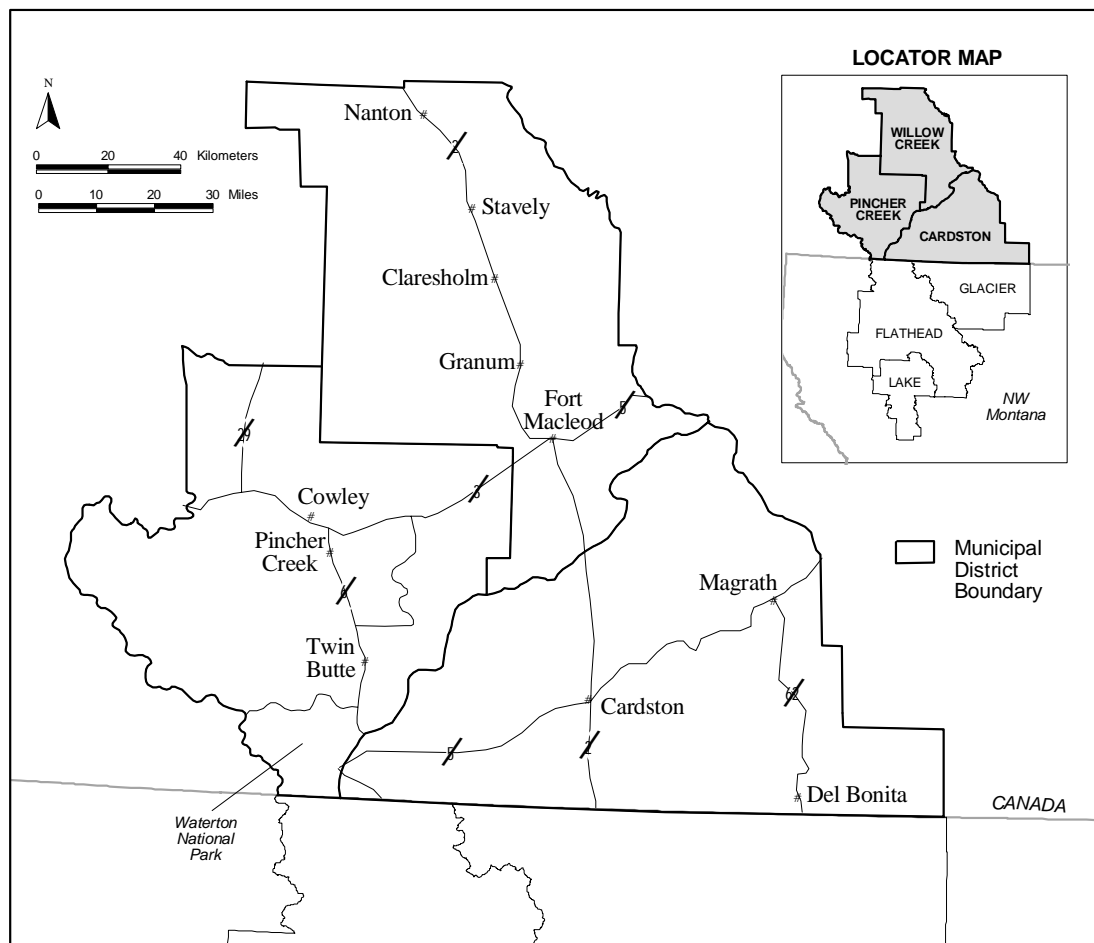
(transportation and health/social services) are predominantly funded by federal revenues.

Southwest Alberta

The portion of the study area located in Canada is the part of southwest Alberta Province that surrounds the Park and connects to the United States at three border crossings north of Glacier County, Montana (Figure 16). The area, defined as Alberta Census Division 3, includes the municipal districts of Pincher Creek, Willow Creek, and Cardston, many incorporated villages and towns, the WLNP and the Town of Waterton, and two First Nation (North American Indian) Reserves. The border crossings between Montana and southwest Alberta are Chief Mountain (Montana 17 to Alberta 6), Carway (U.S. 89 to Alberta 2) and Del Bonita (Montana 444/213 to Alberta 62). This section discusses information on land ownership, economic conditions, employment, and other economic characteristics of the Alberta portion of the study area.

Land Ownership. The land area of the study area in Canada is about 5,324 square miles (13,790 square kilometers). Much of the study area is private land. WLNP is the largest block of public land within the southwest Alberta study area. The Blood Band Reserve (526 square miles; 1,362 square kilometers) and the Piegan Nation Reserve (about 176 square miles; 456 square kilometers) are other large areas of special-status land within the study area.

Figure 16. Southwest Alberta Study Area for Socioeconomic Analysis.



Economic Base. Agriculture and mining (primarily oil and gas production) remain key sectors of southwest Alberta's economic base, although mining has been stagnant since the early 1980s. Recently, value added industries like food processing and wood, fiberglass, and cement products manufacturing have grown as contributors to the local job base. Another emerging trend is the growth of the housing, trade, and services sectors because of retirees attracted to the study area by the quality of life and low cost of living. The health care industry is an established presence in southwest Alberta, as are businesses catering to tourists who

visit the region for its natural attractions and recreational opportunities.

Tourism. Visitation to southwest Alberta's parks and attractions peaks in the summer months. The study area is on a popular and heavily promoted travel route that links national parks from Jasper in Canada to Yellowstone in the United States. The major parks along the "Trail of the Great Bear" include Jasper, Banff, Glacier, and Yellowstone. WLNP attracts more than 400,000 visitors per year. Surveys in WLNP and in the "Chinook Country" tourism region of southwest Alberta indicate that from 40 percent to 50 percent of visitors to the study

area are from the United States. The United States-to-Canadian currency exchange rate is favorable to United States visitors, but relative increases in Canadian travel prices may reduce the margin somewhat in the future.

Labor Force and Demographics. In 1996, about 25 percent of the employed labor force in southwest Alberta worked in agriculture, 2 percent in mining, about 5 percent in manufacturing, and about 6 percent in construction. About 8 percent of employed persons worked in the accommodation, food, and beverage industry that supports tourism. Some localities in the region where employment in the tourism-related industries is especially important are the Waterton townsite (45 percent of employed residents), Glenwood (41 percent), Cowley (19 percent), Fort Macleod (15 percent), and Hillspring (12 percent) (Statistics Canada 2001; BBC 2002).

Income. Average household income in the southwest Alberta study area was \$40,427 Canadian in 1996, or about 20 percent lower than the level of \$51,118 Canadian for Alberta as a whole. Average household income for the study area was \$38,562 Canadian in 1991, indicating an average annual rate of increase of 0.9 percent through 1996, or less than the rate of inflation for the period. However, only about 14 percent of the population in the southwest Alberta study area resided in low-income households in 1996, compared to about 18 percent for the province as a whole (Statistics Canada 2001).

Unemployment. The unemployment rate in the southwest Alberta study area was 8 percent in both 1991 and 1996, which is higher than for Alberta as a whole (6.9 percent in 1996) because of the large number of persons employed seasonally in agricultural jobs. There are pockets of very high unemployment within the study area, too, particularly among residents of the Native Reserves

where the unemployment rate averaged about 27 percent in 1996 (Statistics Canada 2001).

Working outside of Canada is uncommon for residents of the southwest Alberta study area. In 1996, only a few dozen persons reported working outside the country, equating to less than one-half of one percent of the employed labor force (Statistics Canada 2001; BBC 2002).

Demographics. The 1999 estimate of the population of southwest Alberta was 41,231, an increase of about 3 percent per year from the 1996 census count of 37,764. From 1991 to 1996, the population of the southwest Alberta study area grew at less than 1 percent per year compared to growth in Alberta as a whole of about 1.9 percent per year. Relative to the province as a whole, the southwest Alberta study area had proportionately more residents in 1996 under the age of 15 (27 percent versus 21 percent) and fewer resident 65 years old or older (12 percent versus 18 percent).

Native North Americans were about 19 percent of the total population of the southwest Alberta study area in 1996. Some Native North Americans live in many of the communities within the southwest Alberta study area, but most live on the region's two Reserves. In 1996, 4,305 Native North Americans resided on the Blood Reserve and 1,645 resided on the Piegan Reserve.

Economic Development and Tourism Promotion. The southwest Alberta study region contains 14 incorporated towns and unincorporated villages. The largest towns, and their populations in 1996, are: Pincher Creek, 3,659; Claresholm, 3,427; Cardston, 3,417; and Fort Macleod, 3,034. All other population centers in the study area had 1996 populations of less than 2,000.

Most towns in the study area have an economic development board and staff, and there are five

chambers of commerce. There are also three regional organizations devoted to economic development and tourism promotion. One of these, the Niitsitapi Tourism Society of Alberta promotes Native North American-centered tourism for the Blackfoot Confederacy. There are notable community-based tourist attractions and events in the towns of Pincher Creek, Claresholm, Cardston, Fort Macleod, and on the Blood and Piegan Reserves.

Housing. Canada's Census Division #3 reported 3 percent vacancies and only 385 vacant units in 1996. No breakdown of these figures between owner and renter occupied is available.

Community Facilities. On the Canadian side of the border, public services are delivered by the Province of Alberta and a number of municipal districts, towns, and villages. Most major public services are provided by Cardston County, the municipal districts of Pincher Creek or Willow Creek, or smaller towns, villages or improvement districts. The services provided by these entities include public safety, water and wastewater, and fire protection.

Schools. In Canada, school services are overseen by educational boards, with direct management of schools provided by school districts and divisions. Although these jurisdictions are not coterminous with municipal boundaries, three districts or divisions service the majority of the study area. The largest of these is the Lethbridge school district, with 18 schools serving 5,524 students in grades one through nine and five schools serving 2,231 students in grades ten through 12. The Livingstone Range school division and the Westwind school district are both somewhat smaller than Lethbridge, with Livingstone housing 28 primary and seven secondary schools with 3,555 and 1,218 students respectively. Westwind serves 3,145 primary

students in 30 schools and 1,082 secondary students in four schools.

Public Revenues and Expenditures. As described above, a number of local government jurisdictions deliver services in southwest Alberta. The largest of these, and most equivalent to the United States counties examined earlier, are Cardston County and the Municipal Districts of Pincher Creek and Willow Creek. In addition, the Province of Alberta delivers other key services.

Municipal Districts. While their budgets range from \$3 million (Cardston) to \$6 million (Pincher Creek), all three of these entities have similar revenue and expenditure profiles. On the revenue side, all depend primarily on property taxes and provincial grants, with these two sources constituting 80 percent of Pincher Creek's revenues, 89 percent of Willow Creek's revenues, and 78 percent of Cardston's revenues. Expenditures in all three areas are heavily weighted toward general government and transportation and utilities. These line items make up 85 percent of Pincher Creek's budget, 91 percent of Willow Creek's budget, and 81 percent of Cardston's budget.

The three jurisdictions are also similar in their debt capacity and tax rates. The three entities together only have \$127,000 in debt, all issued by Pincher Creek and resulting in annual payments of \$10,000. All also have municipal property tax rates ranging from .007 to .008. They levy these property taxes against assessed values that range from \$212 million in Cardston to \$310 million in Willow Creek and \$404 million in Pincher Creek.

Province of Alberta. Alberta's 2001-02 fiscal year estimates provide a revenue forecast of \$22.7 billion. This is projected to come from a number of sources, including non-renewable resource revenues (i.e., royalties) of \$7.5 billion, \$6.1 billion in income

taxes, \$2.4 billion in other taxes, and a variety of other revenue.

It should be noted that Alberta is a relatively low-tax province. It is the only Canadian province without a sales tax or capital tax on financial institutions, one of three provinces without a general capital tax, and one of six provinces without a payroll tax. Alberta's tax base consists primarily of royalties on non-renewable resource extraction, a 10 percent personal income tax, a varying corporate income tax, a fuel tax of 9 cents per liter, and a cigarette tax of \$14 per carton.

Over 70 percent of provincial expenditures consist of learning, health and wellness, and infrastructure development activities, with \$21.6 billion in total expenditures budgeted for 2001-02.

Analysis of Fiscal Condition (per capita). One method of comparing service delivery capacity between the various governmental entities is expenditures per capita. While this measure is somewhat clouded by the varying services delivered by different entities, it is suggestive of service levels. Table 25 presents expenditures per capita for the three United States counties, as well as the Canadian jurisdictions.

The service levels provided by each of the governments appear relatively comparable. Large per capita expenditure in Glacier County is largely due to the presence of a county hospital, which is not provided in other areas. Without the hospital, Glacier's per capita expenses drop to below \$500.

CULTURAL RESOURCES

While GNP is perhaps best known for its tremendous natural setting and renowned ecological resources, the Park is also home to many significant cultural resources. The Going-to-the-Sun Road

Table 25. Expenditures per capita.

Location	Budget [†]	Population	Budget per Capita
Flathead County	\$61,199,505	74,471	\$822
Glacier County	\$13,834,856	13,247	\$1,044
Lake County	\$18,163,487	26,507	\$685
Cardston County [‡]	\$2,931,763	4,565	\$642
M.D. of Pincher Creek [‡]	\$2,730,409	3,172	\$861
M.D. of Willow Creek [‡]	\$3,789,561	5,091	\$744

[†]Total expenditure budgets are used throughout. 1999 budgets are used for Canadian jurisdictions, while 2001 budgets are used for United States counties.

[‡]Budgets have been converted to United States dollars at an exchange rate of \$1.60 Canadian to \$1.00 United States.

Source: Alberta Municipal Affairs 2002; Montana County Budgets 2001

itself is among these important cultural resources, and others are immediately adjacent to the Road corridor. Consequently, federally mandated cultural resource considerations will play an important part in the planning process for Road rehabilitation.

The National Historic Preservation Act (NHPA) of 1966 (as amended), and its implementing federal regulations (36 CFR 800), require federal agencies to consider effects on cultural resources before undertaking any actions. Cultural resources are defined as buildings, structures, objects, sites, or districts that display significant associations to American history, architecture, archaeology, engineering, or culture. Cultural properties may be historic or prehistoric, and may be intact resources or the archaeological remnants of sites. Cultural resources that meet certain federal criteria of

significance and integrity may be found eligible for inclusion in the NRHP. If a proposed federal project would adversely affect an NRHP-eligible resource, measures must be developed and implemented to minimize or mitigate those effects. As noted below, a number of NRHP-eligible resources have been identified in the Road corridor.

The planning process for a federal undertaking must include a systematic procedure to identify and locate potentially significant cultural resources within a project's impact area. This is typically a multi-faceted process, including a file and records search for previously recorded cultural properties, as well as field survey to locate previously unrecorded sites. Significant research and fieldwork already have been conducted in the Park, and most of the major cultural resources likely to be affected by Road rehabilitation work are documented. Systematic pedestrian archaeological surveys have also been conducted along much of the Road corridor, except for the segment between The Loop area and Logan Pass. These survey corridors are relatively narrow, however, and some potential staging sites and other areas of potential impact have not been inventoried. Federal regulations mandate the completion of such a survey prior to the beginning of any undertaking in the Road corridor that may impact undisturbed land. Depending on the nature of specific planned work projects, limited additional cultural resource survey may be required.

Archaeological Resources

Archeological sites are the locations of past human occupation or activity that retain physical evidence of prior use. Sites may be prehistoric (with use predating Euro-American occupation), or historic. Those archeological sites found eligible for the NRHP are typically eligible because they have



Triple arches

yielded, or are likely to yield, information important to the study of history or prehistory.

The immediate Going-to-the-Sun Road corridor includes known historic and prehistoric archaeological sites, and likely includes additional unrecorded sites. The probability of prehistoric sites is greatest along the lower reaches of the Road, where geographic and climatic conditions made extended Native American use far more likely. Higher-elevation locations along the Road corridor may have seen occasional prehistoric use as Native American travel routes, but overall are far less likely to retain physical evidence of such use.

Overall, the likelihood is greater that significant historic archaeological sites will be found along the Going-to-the-Sun Road corridor. These sites may reflect a variety of historic activities in the Park, including:

- The construction and maintenance of the Road itself;
- Pre-1910 occupation and use of the Park by homesteaders and others;
- Visitor accommodations, camping, and other tourism-related activities;
- NPS administrative activities; and
- Historic trails and other travel routes.

Several historic archaeological sites related to the construction and early reconstruction of the Road are known to exist in the Road corridor; few, however, have been formally recorded. Known or potential sites include the locations of former Road Camps, particularly on the west approach to Logan Pass; the locations of abandoned construction equipment; the sites of historic dumps; and other staging areas for historic construction projects. Former alignments of the Road itself (such as along upper McDonald Creek) are also potentially significant sites.

Archaeological sites relating to pre-1910 use of the Park area are more likely to be found in the former or current private inholdings in the Apgar/Lake McDonald area. Tourism-related sites potentially exist at any of the current or former developed areas along the Road, including Apgar, Lake McDonald, Avalanche, Sun Point, and Rising Sun (for example, a sawmill once existed alongside the Road near Lake McDonald Lodge, and the Sun Point area had a variety of historic uses associated with the former Going-to-the-Sun Chalets). NPS administrative activities historically took place at several locations along the Road, and an historic NPS telephone line formerly traversed Logan Pass. Numerous former trails intersect the Road, including old pack trails used during the Road's construction and abandoned tourist trails such as the Alder Trail and the former trail over Logan Pass. Few of these sites have been identified, located, or mapped. To ensure the identification and protection of such sites, Road projects that involve the disturbance of uninventoried, previously undisturbed ground will require the completion of an archaeological inventory prior to the beginning of work. Information on the scope of prior archaeological survey in the Park, and data on previously recorded sites, is on file at the Glacier National Park Archives. To reduce the chance of vandalism at cultural sites, specific locational information for

many archaeological sites is not released to the public, and is therefore not included in this report.

Historic Resources

A significant number of historic resources along the Going-to-the-Sun Road corridor are listed in, or eligible for, the NRHP, including the Road itself. The historic significance of the Road has been well recognized by the federal government and others. The Road was listed on the NRHP in 1983; was designated a National Historic Civil Engineering Landmark in 1985; was documented by the Historic American Engineering Record (HAER) in 1990; and was designated a National Historic Landmark by the Secretary of the Interior in 1997. The latter distinction is the most noteworthy and restrictive, and affords the Road and its cultural resources the highest possible level of federal protection.

The Road is considered significant for its history, its design, and its engineering. As an early example of a major national park roadway, the Road represents a pioneering federal attempt to design and construct an automobile road that both harmonized with its environment and showcased its natural surroundings. These design philosophies, as embodied in the Road, became a model for future parkway projects to follow. The engineering and landscape architecture techniques used in the Road further reflected this design philosophy, featuring well-crafted stonework and gently curving walls that blended perfectly with the spectacular natural setting.

Both the NRHP and National Historic Landmark nominations include the length of the road from the foot of Lake McDonald to St. Mary. While the entire roadway corridor between those points is subject to National Historic Landmark provisions, both nominations also include lists of key individual historic structures that are part of the road —

primarily bridges and tunnels. The HAER documentation also recognizes the entire roadway corridor, while further documenting some 17 individual bridges and other structures along the Road (including the now-bypassed Belton Bridge).

The sites specifically documented in the NRHP and HAER materials for the Road represent only a small fraction of the significant historic features associated with the roadway. The Road's important historic engineering features include bridges, culverts, and overpasses; retaining walls and guardwalls; two tunnels; and other structural and design elements. Most of these features were constructed of native stone, and display high-quality craftsmanship and extremely sensitive design. Broader elements of the Road's design are also considered significant, such as its alignment and width. Discussions and evaluations of the Road's historic features are provided in the *Cultural Landscape Report* for the Road (RTI 2002).

In addition to the Road itself, a number of other resources listed on (or found eligible for) the NRHP exist along the Road corridor; most are buildings or groups of buildings (districts). These resources are listed in Table 26, and are briefly described in the paragraphs that follow. Only those resources located within approximately 0.25 miles (0.4 kilometers) of the current roadway corridor are listed; other NRHP-eligible resources also exist in the broad vicinity of the Road, but beyond that threshold.

The **Headquarters Historic District** includes the original Park headquarters building, its associated historic NPS housing area, and the main Park maintenance facility. The district includes some 73 historic buildings, dating from the 1910s to the 1940s. The original alignment of the Going-to-the-Sun Road (now bypassed) also passes through the district. The current Road alignment, which dates from 1936, bypasses the district about 0.2 miles (0.3

kilometers) to the west. A low hill and heavy forest fully screen the Road from the historic district.

Table 26. Significant historic resources in the Going-to-the-Sun Road corridor.

Name	Location	Status
Headquarters Historic District	E. of roadway, near MP 0.6	NRHP
West Entrance Station	On roadway, MP 0.9	NRHP
Lake McDonald Lodge	W. of roadway, near MP 10.9	NRHP; NHL
Logan Creek Snowshoe Cabin	S. of roadway, MP 20.9	NRHP
Logan Pass Visitor Center	S of roadway, near MP 32.0	Potentially NRHP eligible
South Circle Trail	Crosses roadway, near MP 36.6	NRHP
Baring Creek Fireguard (Snowshoe) Cabin	N. of roadway, MP 39.8	NRHP
Rising Sun Motor Inn	N. of roadway, near MP 43.9	NRHP
St. Mary Visitor Center	N. of roadway, MP 49.5	Potentially NRHP eligible

The **West Entrance Station** is a stone and log structure erected in 1940, and slightly enlarged in the 1960s. An excellent example of NPS rustic architecture, the facility continues to serve as the primary initial contact point for Park visitors arriving from the west.

Lake McDonald Lodge is a handsome, rustic hotel dating from 1913-14. The building is a National Historic Landmark. The Lake McDonald Lodge Historic District, which surrounds the hotel, includes a number of log guest cabins and ancillary buildings. The lodge, known originally as "Lewis Glacier Hotel," has long been the focal point of visitor activity on the west side of the Park. While the current Road alignment bypasses the historic district



Original road construction

to the east, some of its buildings are briefly visible to travelers on the Road. In addition, a former alignment of the Road (now an access lane) passes through the district.

The **Logan Creek** and **Baring Creek Snowshoe Cabins** are single-room log cabins used primarily for winter backcountry patrols. Both are well-preserved examples of NPS rustic architecture. The Logan Creek cabin (1924) was used by the surveyors who laid out the Road's western approach to Logan Pass. Of the two buildings, only the Logan cabin is briefly visible to travelers on the Road.

The **Logan Pass** and **St. Mary Visitor Centers**, both dating from the mid-1960s, are the largest NPS visitor contact facilities along the Road. The buildings may be eligible for listing in the NRHP for their associations with the Mission 66 era — an important NPS-wide development and improvement program (1956-66). They have not been evaluated for NRHP eligibility. The Logan Pass building and its associated parking lot are highly visible from the Road; the St. Mary center is immediately adjacent to the Road and incorporates an entrance station facility for Road travelers.

The **South Circle Trail** crosses beneath the Road at Jackson Glacier Overlook, utilizing a nearly-invisible historic horse underpass. The trail is significant as a primary route of the multi-day horseback excursions that were characteristic of the visitor experience in Glacier between the 1910s and the 1930s. The trail segment crossing the road extends from Sun Point to Piegan Pass and Many Glacier. It is important to note that several other historic trail routes meet or cross the Road; while they have not been formally evaluated, some are certainly NRHP-eligible.

Rising Sun Motor Inn is a small concessionaire facility with buildings dating from 1940 and beyond. The property is considered significant as a well-preserved example of a Park tourist facility geared toward automobile travelers. Historic resources at the site include the original store/restaurant building, a series of guest cabins, and other ancillary structures; only the store building is readily visible from the Road. A non-historic 1960s coffee shop building dominates the view of Rising Sun for Road travelers.

In addition to the significant historic sites noted above, other recorded or unrecorded historic resources may exist in the immediate Road corridor, and some may be NRHP-eligible. A small number of unevaluated architectural resources are known to exist, including small Mission 66 buildings at Avalanche, and a number of inholder-owned summer cabins along Lake McDonald. Other types of resources with potential historic significance include intersecting roads and trails, historic communications systems, former Road alignments, and others.

As with the archaeological resources in the Road corridor, it is possible that additional unrecorded historic resources exist in areas that may be impacted by Road projects. Cultural inventory of

unsurveyed areas will be required in order to identify any such resources prior to the beginning of work.

Ethnographic Resources

While the previously discussed cultural resources are tangible and human-made, ethnographic resources are typically far more broad-ranging. By definition, ethnographic resources are tangible or intangible aspects of a cultural system, past or present, that have been identified as significant to a recognized ethnic group. Ethnographic resources can include a tremendous variety of natural and cultural objects, materials, and locations. Examples could include plant materials used in traditional medicine; mineral outcroppings used in the crafting of tools or weapons; locations traditionally associated with vision quests or other cultural ceremonies; and mountains associated with creation stories or religious tradition.

While the NHPA was not specifically constructed to address these resource types, other federal laws and regulations require the consideration of ethnographic values, including the American Indian Religious Freedom Act of 1978 (AIRFA) and the Native American Graves Protection and Repatriation Act. This legislation — and NPS policy — mandate the protection of resources and sites in the Park that are culturally significant to Native American and other ethnic groups.

Significant ethnographic resources within the immediate Going-to-the-Sun Road corridor have not been previously identified, but other sites in Glacier, such as Chief Mountain and Going-to-the-Sun Mountain, have long been recognized as having ethnographic significance. GNP has just completed an ethnographic overview; this and other future research will help increase awareness of ethnographic values in the Park.

Cultural Landscapes

As defined by the NPS, a cultural landscape is “a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein), associated with an historic event, activity, or person, or exhibiting other cultural or aesthetic values.” The Going-to-the-Sun Road has long been recognized for its careful and uniquely designed spatial relationship with its surrounding geography, and is thus seen as being part of a broader, significant cultural landscape. Similar natural/historic associations exist in the Lake McDonald Lodge area and elsewhere in the Park. While these landscapes have not been documented to National Register standards, they are almost certainly NRHP-eligible.

The cultural landscape concept has a direct bearing on planning actions related to future Road rehabilitation. Projects impacting the natural setting of the Road, or views from or of the Road, are a potential adverse effect on the Road’s cultural landscape. Similarly, changes to the Road or its setting could impact the landscape of significant historic resources near the Road, such as Lake McDonald Lodge.

As part of the planning process for future Road rehabilitation, a *Cultural Landscape Report* for the Road was completed in 2002 (RTI 2002). This report documented the history and landscapes of the Road.

NATURAL RESOURCES

Topography, Geology, and Soils

Topography

GNP is located along the northern spine of the Rocky Mountain chain. The 50-mile (80-kilometer) Going-to-the-Sun Road spans the Continental Divide and provides views and access to spectacular high mountain scenery. Elevation along the Road ranges from about 3,150 feet (960 meters) at Lake McDonald to 6,640 feet (2,025 meters) at Logan Pass and back down to 4,480 feet (1,365 meters) at St. Mary Lake. A diversity of topographic and landscape features shaped by dramatic geologic processes are present along the Road. Gently sloping glaciated valleys and deep lakes are present at the base of the east and west sides of the steep rugged mountain range bisected by the Going-to-the-Sun Road.

Geology

The geologic material present along the Going-to-the-Sun Road is composed of some of the oldest and best preserved sedimentary rock in the world (Rockwell 1995). Between Lake McDonald and St. Mary Lake the Road crosses through seven geologic formations. Lake McDonald was carved out of the valley by glacial activity and remnants of the unconsolidated gravels deposited by glaciers are evident along this segment of the Road. Active slumps that cross the Road are present in these glacial deposits adjacent to Lake McDonald. The dark gray to black argillite and siltite of the Prichard Formation is evident along McDonald Creek several miles upstream from Lake McDonald (Raup et al. 1983). Further upstream to Avalanche, the Road crosses the Appekunny formation, which has



The Going-to-the-Sun Road crosses the Helena Formation

preserved the ripple marks of the deep lake bottom sediments from which it was formed. At Red Rock Point, exposed red argillite and siltite layers of the Grinnell Formation are visible at this popular pullout. As the Road continues to climb east of Red Rock Point, green and gray argillite of the Empire Formation are visible in road cuts. At The Loop, the colorful rocks of Snowslip Formation are present and ripple marks from tidal flat depositions are exposed.

As the Road climbs toward Logan Pass over to the east slope as far as the Jackson Glacier Overlook, the Helena Formation is dominant. The dolomite and limestone rock of the Helena Formation contain an abundance of fossil algae. Near the West Tunnel, a narrow dark igneous sill cuts through the Helena Formation. Many of the steep rockfall hazard areas are included within eroding cliffs of this formation. As the Road continues east from the Jackson Glacier Overlook, it again crosses the Empire and Grinnell

Formations. The upper end of St. Mary Lake borders the Appekunny Formation. Near Rising Sun the light colored dolomite and limestone of the Altyn Formation is visible in road cuts. From this point east to the town of St. Mary, geologic material includes a mixture of different rock deposited from landslides, glacier, and alluvial activity.

Soils

The soils along the Going-to-the-Sun Road are a product of the weathering of the parent materials described above and as modified by topography, vegetation, erosion, and climate. There are three major groups of soil common along the Road (Dutton et al. 2001). These include: 1) glacial, landslide, and mixed soils; 2) bedrock soils derived from quartzite and argillite; and 3) bedrock soils derived from limestone. In addition, small areas of alluvial and wet soils are present. Although soil characteristics vary substantially with location, most soils have loamy textures due to wind blown volcanic ash deposits dated from about 7,000 years ago.

Glacial, landslide, and mixed soils formed in glacial deposits contain a mixture of semi-round rock and cobble. These soils are found primarily along the McDonald Creek drainage, Reynolds Creek, and St. Mary Lake. Soil textures include silty clay loams, sandy loams, and clay loams. Soils within this group vary widely over short distances due to mixing and landslides. Coniferous subalpine forest covers most of these soils. Erosion potential is high when these soils are disturbed due to the loamy and silty surface soil textures and limited rock content. Productivity and revegetation potential varies from low to high depending on soil texture, rock content, and water and nutrient holding capacity.

Bedrock soils derived from quartzite and argillite are found on mountaintops and ridges. This soil group

is found along the Going-to-the-Sun Road adjacent to Lake McDonald where the Belton Hills border the lake and along the northwest shore of St. Mary Lake. These soils typically have loam to silt loam surfaces with coarse rock fragments in the subsoil. Vegetation cover for these soils near the Road is mostly coniferous forest. Erosion potential is high when vegetation is removed due to the silty and sandy surface soil texture. Subsurface horizons are generally less erosive because of the high rock content. Productivity and revegetation potential is moderate.

Bedrock soils derived from limestone are found on mountainside slopes and ridges from the West Tunnel to Siyeh Bend. Soils in this group vary from shallow to deep depending on the position on the landscape. Loam and sandy loam surface textures are common, with rock content increasing with depth. Large areas of rock outcrop are present with steep rock cliffs and broken loose talus slopes. Soil material is limited where surface rock dominates the landscape. Existing vegetation ranges from coniferous forest at lower elevations to alpine meadows at higher elevations. Erosion potential is moderate, but may range from low to high depending on the soil texture, slope, and the amount of anchoring rock present. Productivity and revegetation potential is generally low to moderate due to the low moisture and nutrient holding capacity, presence of rocks, and the harsh climate at higher elevations.

Other soil types present along the Going-to-the-Sun Road corridor include small areas of alluvial and wet soils. Alluvial soils are found along streams and drainages where soil and rock material are deposited by flowing water. Alluvial soils are found in several locations along the McDonald Creek drainage and adjacent to St. Mary Lake. The composition of alluvial soils varies widely, but is generally characterized by coarse textures and unconsolidated

coarse fragments from periods of deposition. These soils may support riparian deciduous vegetation, coniferous forest, or transitional shrubs and grasses. The erosion potential is moderate and these sites are subject to periodic flooding. Productivity and revegetation potential is low where well-drained coarse soils are present and high where finer textured material with high organic matter is present. Wet soils are found where the water table is shallow near lakes, ponds, seeps, and drainages. These soils are rich in organic matter and have loamy to silty textures. Vegetation on wet soils may include sedges, willows, cottonwoods, and other riparian species. Erosion potential is low and productivity and revegetation is high on wet soils.

Sandy and gravelly alluvial soils are the most susceptible to invasion by exotic weed species, particularly in floodplain locations where periodic disturbances expose bare soil (Dutton et al. 2001). Soils least susceptible to exotic weed invasion are located at higher elevations (>6,000 feet; 1,830 meters), and wet soils, since few exotics can compete with native species in these locations. All other soils are similar in their potential for weed invasion depending on the amount of disturbance and sunlight.

Water Resources

GNP is often referred to as the Crown of the Continent because three watershed divides are located within the Park. The triple divide is located about 7 miles (11 kilometers) south of St. Mary Lake. Streams west of the Continental Divide drain to the Columbia River Basin and the Pacific Ocean, east of the Continental Divide water flows to either the Saskatchewan River and Hudson Bay or the Missouri River and Atlantic Ocean.

The west side of the Going-to-the-Sun Road is located within the McDonald Creek watershed,

which drains into the Middle Fork of the Flathead River near West Glacier (Figure 2). The Road parallels McDonald Creek and Lake McDonald throughout the valley until it begins climbing toward Logan Pass. The Road crosses several tributaries to McDonald Creek and Lake McDonald, including Sprague Creek, Snyder Creek, Avalanche Creek, Logan Creek, Haystack Creek, and Alder Creek.

The east side of the Going-to-the-Sun Road falls within the St. Mary River drainage, which is in the Hudson Bay watershed. Reynolds Creek and St. Mary Lake are the primary water features near the Road (Figure 2). Principal tributaries to these drainages crossed by the Road include, Siyeh Creek, Baring Creek, Rose Creek, Two Dog Creek, St. Mary River below the Lake, and Divide Creek.

The majority of the Park's precipitation occurs during the winter months from November to March. Maritime Pacific air masses bring high amounts of snowfall to both sides of the Continental Divide (Rockwell 1995). West Glacier receives about 30 inches (76 centimeters) of precipitation annually and St. Mary about 26 inches (66 centimeters) annually. Along the Continental Divide, average snowfall ranges from about 800 to 1,000 inches (2,032 to 2,540 centimeters) or 100 inches (254 centimeters) of precipitation.

Floodplains

Peak runoff for the streams in the Going-to-the-Sun Road corridor occurs during the spring in response to snowmelt or during summer thunderstorms. The 100- and 500-year floodplains in the Park have only been determined near developed areas along the North and Middle Forks of the Flathead River and lower McDonald Creek. The 100-year floodplain for McDonald Creek may extend into portions of the Apgar Village, but does not include the Going-to-the-Sun Road. Information on floodplain boundaries

for other drainages along the Road corridor are incomplete, but previous studies and inferences based on terrain and observations during flood events provide an indication of floodplain areas.

The portions of the Going-to-the-Sun Road likely to lie within the 100-year floodplain include:

Sprague Creek. The 100-year floodplain probably includes portions of the Sprague Campground, picnic ground, and the Going-to-the-Sun Road.

Snyder Creek. Snyder Creek crosses the Road near the Lake McDonald Lodge and previous studies by the U.S. Army Corps of Engineers have estimated the 100-year floodplain (COE 1983). The extent of the floodplain could change with shifts in the Snyder Creek channel or debris blockage at the Snyder Creek Bridge over the Road.

Avalanche/McDonald Creek. The 100-year floodplain includes the picnic area and toilet, a portion of the Going-to-the-Sun Road, but not the campground.

Rose Creek. Rose Creek crosses the Road between the Rising Sun development and St. Mary Lake. The floodplain on Rose Creek is potentially located south of the Road, where the Road acts as a barrier and north of the Road in the Rising Sun development (Land and Water Consulting, Inc. 2001).

Divide Creek and St. Mary River. Divide Creek frequently cuts new channels through lower portions of the flat alluvial floodplain, which results in periodic flooding near the Road. The alluvial fans along Divide Creek to the St. Mary River are considered to be within the 100-year floodplain. This includes a portion of the Going-to-the-Sun Road, but not the St. Mary Visitor Center, according to U.S. Army Corps of Engineer investigations (Omang et al. 1983). However, the Divide Creek channel is very unstable and the floodplain may shift



Lost Lake near the Going-to-the-Sun Road

(Smillie and Ellerbroek 1991). The transport and deposition of glacial material by Divide Creek near the Going-to-the-Sun Road bridge crossing have raised the level of the streambed, which further increases the potential for flooding.

Other high gradient drainages that cross the Going-to-the-Sun Road are subject to periodic high flows, channel scouring, debris flow, and local flooding. These smaller streams generally have incised channels, but during periods of high runoff from thunderstorms or rapid snowmelt, streamflow may occasionally flood portions of the Road. The deposition of debris near bridge crossings, such as Logan Creek, has reduced the hydraulic capacity of the bridge, which may increase the potential for flooding.

Water Quality

The water use classification for the streams in GNP is A-1 (Montana Water Quality Act ARM 17.30.608). The A-1 classification denotes high

quality water suitable for drinking and culinary food processing following conventional treatment, bathing, swimming, and recreation, growth and propagation of salmonid fishes and aquatic life, waterfowl, furbearers, and agricultural and industrial water supplies (Montana Water Quality Act ARM 17.30.622).

A water quality monitoring program conducted between 1984 and 1990 provides an indication of the baseline water quality in the Going-to-the-Sun Road corridor (Ellis et al. 1992). The study included chemical, physical, and biological sampling of Lake McDonald and St. Mary Lake, as well as other frontcountry and backcountry lakes. Lake McDonald borders the Going-to-the-Sun Road on the west side of the Divide and is located in the lower McDonald Creek watershed. St. Mary Lake borders the Road on the east side of the Divide and extends to the Road terminus. Thus, both lakes are influenced by the Road, recreational activities, other developments, and natural erosion within these watersheds.

The Ellis study (1992) determined that both Lake McDonald and St. Mary Lake have extremely good water quality with no measurable pollutants. These lakes have few dissolved solids because of the low dissolution rates of the bedrock. As a result, the lakes have a low buffering capacity and are sensitive to acidic deposition. Both lakes are very low in nutrients and productivity because of low phosphorus and would be extremely sensitive to phosphorus loading. Phosphorus concentrations in Lake McDonald ranged from <1.0 to 10.5 µg/l and from 1.3 to 7.0 µg/l for St Mary Lake. Low productivity is indicated by the low amount of phytoplankton (largely algae) and zooplankton (tiny animals) present in both lakes, although St. Mary had higher densities than Lake McDonald.

Water quality is influenced by natural processes as well as human activities. During spring runoff, high water velocities transport sediment and the turbidity of streams increases. The rock flour produced by the erosive action of glaciers contributes to the milky color of streams and the aqua blue and green shades present in lakes. Thunderstorms generate short intense periods of runoff and high gradient drainages and avalanche chutes often carry large volumes of debris and sediment.

Although measurable amounts or trends in pollution were not evident from water quality sampling, human activities in the watershed may be contributing small amounts of pollutants. Evidence of sedimentation from original Road construction was discovered from sampling of lake bottom sediments in Lake McDonald (Spencer 1991). Current possible pollutant contributions to the streams and lakes influenced by the Road include sediment from roadway sanding, hydrocarbon and metal contaminants from vehicle emissions, and deposition and erosion of roadside cut and fill slopes. Other human sources of contaminants are possible at campgrounds, picnic areas, and land disturbances that generate non-point sources of pollution. There is some concern that increases in atmospheric nitrogen concentrations, particularly in alpine and subalpine environments with large annual snowfall could affect the nutrient balance in the Park ecosystem. Snowpack analysis of chemical loading in GNP indicates the potential for significant impacts to the alpine ecosystem if atmospheric nitrogen concentrations increase in the future (U.S. Geological Survey 2001).

Vegetation

GNP is located astride the northern-most reach of the Rocky Mountains in the continental United States, and forms a transition area between the

intermountain Northwest and the Great Plains. Biodiversity in the Park is very high because the Park is located in a transition zone between continental and Pacific maritime climates. Plants and animals in the colder climes of northern mountains intermingle with plants and animals found in the southern and coastal ranges. Past glaciation has isolated many plant populations, and the varied terrain provides a broad range of microclimates for a wide variety of plant communities on both the east and west sides of the Continental Divide. Consequently, the geographic location and topographic gradients of the Park have fostered and sustained an ecology that includes the plants and animals of a much larger region. The Park is at the core of the “Crown of the Continent” ecosystem, one of the most ecologically intact areas remaining in the temperate regions of the world.

Because of the biological diversity and significance, GNP has been designated as a Biosphere Reserve and Waterton-Glacier International Peace Park has been designated as a World Heritage Site. Natural resources are managed in accordance with NPS policy to “try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems” (NPS 2001b).

GNP supports over 1,100 species of vascular plants (Lesica 2002), about 870 non-vascular plants (DeBolt and McCune 1993; Hermann 1969; Elliott 1987; Haybeck 1963), and a diversity of vegetation communities associated with the wide range of elevation, topography, aspect, and moisture. Fire is the dominant ecological disturbance throughout the Park and has undoubtedly influenced the diversity and heterogeneity of the community types and landscape. Other natural disturbances that contribute to diversity include avalanches,

landslides, windstorms, floods, diseases, and insect infestations.

The project area includes western red cedar/western hemlock forests on the west side of the Road corridor; subalpine fir/Engelmann spruce forests at the higher elevations; and Douglas-fir forests at lower elevations, especially within the St. Mary Valley. Aspen parklands and fescue grasslands are found at lower elevations on the eastern end of the project area. Riparian areas dominate bottomlands along lakes, rivers, and streams. The distribution of the vegetation communities along the Going-to-the-Sun Road is discussed below.

Western Red Cedar/Western Hemlock Forests

On the west side of the Road corridor, the vegetation within the lower McDonald Valley is dominated by several successional stages of the moist western red cedar/western hemlock forest type. McDonald Valley is the easternmost location in which this forest type exists, reflecting the influence of the Pacific maritime climate. Since red cedar and



Old growth western red cedar and western hemlock forest at Avalanche

hemlock do not establish quickly in recently opened stands, areas that have had more recent fires are dominated by pioneering species such as lodgepole pine, western larch, aspen, paper birch, and black cottonwood. As these forests mature, Douglas-fir, western larch, Engelmann spruce, and western white pine become more important, dominating the overstory in various proportions. Western hemlock and western red cedar dominate late seral and old growth stands that are often centuries in age in several locations. The vegetation surrounding the Lake McDonald Lodge includes a complex of 230-year old western red cedar and numerous old growth black cottonwood trees (Barrett 1997). At Avalanche Creek an old-growth stand of the more rare western red cedar/devil's club habitat type is present. The Avalanche site is probably the largest nearly intact cedar/devil's club community in the state and is ranked state and globally "vulnerable" (S3/G3) by the Montana Natural Heritage Program.

Subalpine fir can be found in several successional stages, while a few scattered grand fir occur only in later-seral forests. Common understory species within these forest types include huckleberry, spiraea, snowberry, twinflower, beargrass, round-leaved violet, pinegrass, and queencup beadlily. While most of these forest communities fall into the western red cedar/queencup beadlily habitat type, several areas are within the more rare western red cedar/devil's club and western hemlock/queencup beadlily habitat types due to topography, elevation, slope and climatic influences around Lake McDonald. Scattered Douglas-fir habitat types are also present in this area.

Areas near Apgar and the Park headquarters contain various successional stages of the western red cedar/western hemlock forest type, including forest communities dominated by lodgepole pine and communities dominated by red cedar, hemlock, and other mixed conifers. Other trees regenerating in the

understory include western red cedar, western hemlock, western white pine, and Douglas-fir. Black cottonwood and paper birch are present in forest openings.

Subalpine Fir/Engelmann Spruce Forests

As elevation increases from both the McDonald and St. Mary Valleys along the Road, the forest transitions to a subalpine fir/Engelmann spruce forest type. Transition zones prior to The Loop on the west side of the Park encompass tree species from both the western red cedar-western hemlock and Engelmann spruce/subalpine fir forest types. Lower subalpine forests, particularly west of the Continental Divide, may still have Douglas-fir, western larch, and western white pine. Common understory species for these subalpine forest communities include fool's huckleberry, mountain ash, spiraea, arnica, twinflower, queencup beadlily, grouse whortleberry, and arrow-leaved groundsel. Higher elevation forests support beargrass, glacier lily, mountain-heather, and woodrush in the understory. Areas that have had more recent fires have more paper birch, quaking aspen, lodgepole pine, western larch, and scattered Douglas-fir. Tall shrub communities within avalanche chutes dominate most of the upper Road and include species such as green alder, serviceberry, elderberry, fireweed, and cow parsnip. Higher still in elevation near Logan Pass, the subalpine fir and Engelmann spruce take on wind- and frost-stunted shrubby forms called krummholz. Beyond these areas lie diverse alpine meadows, turf communities, wet meadows, talus slopes, and fellfields that support a number of rare plants.

To the east of the Continental Divide, the subalpine fir/Engelmann spruce forests continue along most of the Road. Whitebark pine becomes a part of the overstory near Siyeh Bend and the forest is

interspersed with beargrass/low shrub meadows and steep talus slopes. Pockets of limber pine can also be found above and below the road near Sun Point. Engelmann spruce and subalpine fir grow on the lower moist slopes above St. Mary Lake, often with lodgepole pine and sometimes with components of black cottonwood and aspen. Drier spruce/fir forests tend to fall within the subalpine fir/dwarf huckleberry or subalpine fir/twinflower habitat types, while moist spruce/fir forests are generally subalpine fir/queencup beadlily or subalpine fir/grouse whortleberry habitat types.

Douglas-Fir Forests

At lower elevations within the St. Mary Valley, Douglas-fir tends to occupy the warm, dry exposures, forming a mosaic pattern of communities with Engelmann spruce-subalpine fir elements. Douglas-fir forests can be found on the dry mid-slopes, often mixed with lodgepole pine, subalpine fir, Engelmann spruce, and limber pine. The understory also tends to be dry, characterized by species often found in the nearby grasslands, as well as common juniper and kinnikinnick. Fescue grasslands lie to the east of Rising Sun, along both sides of the Road. Lodgepole pine and Douglas-fir have started to invade these meadows along their western front. Grassland vegetation also dominates the understory in the open-canopy Douglas-fir/limber pine areas.

Aspen Parklands

Along the eastern border of the St. Mary Valley, aspen groves intermix with grasslands to form extensive parklands. Aspen, sometimes mixed with black cottonwood, Engelmann spruce, lodgepole pine, and Douglas-fir, extends along the low slope and toeslopes above St. Mary Lake, particularly along the eastern end. The understory of these

groves is comprised of snowberry, serviceberry, red-osier dogwood, prickly rose, cow parsnip, western sweet-cicely, showy aster, arnica, western meadowrue, and various grasses.

Fescue Grasslands

Alluvial fans, interspersed within the aspen groves, are dominated by fescue grasslands. The vegetation is comprised of grasses such as Idaho fescue, rough fescue, bluebunch wheatgrass, oatgrass, needlegrass, and sedges. Dominant forbs include silky lupine, slender cinquefoil, yarrow, and balsamroot. These grasslands can also be found as dry outcrops along the mountain slopes. Areas around the St. Mary Visitor Center, St. Mary Flats, and Two Dog Flats are dominated by fescue grassland with isolated shrublands.

Riparian Vegetation

Within the McDonald Valley, McDonald Creek, Snyder Creek, the shoreline of Lake McDonald, Avalanche Creek, Logan Creek, and other west side streams support riparian vegetation. Common riparian forests include western red cedar and Engelmann spruce with black cottonwood and paper birch in the overstory. Understory plants include mountain maple, red-osier dogwood, alder, willow, and sedges. Similar trees were found along the shoreline of Lake McDonald, although Douglas-fir, Engelmann spruce, and a few subalpine fir seedlings are also present. At popular lakeshore and streambank sites, the understory vegetation is often denuded from human trampling.

Riparian areas are also present along upper subalpine and alpine drainages, streams, and avalanche chutes where forest cover diminishes. Shrubby and herbaceous species dominate these sites and may include plants such as green alder,

serviceberry, thimbleberry, elderberry, cow parsnip, three-flowered rush, Glacier lily, alpine bluegrass, mountain heather and sphagnum, and a variety of mosses.

The shoreline of St. Mary Lake falls mostly within the Engelmann spruce-subalpine fir forest type, although scattered black cottonwood and lodgepole pine are present. Willow and alder are most prevalent along the rocky shoreline. Riparian vegetation can also be found along Rose Creek. The creekbed is very rocky but scattered black cottonwood, Engelmann spruce, and some lodgepole pine are scattered in the floodplain. Willows and alder are also present here.

Noxious Weeds

The flora of GNP also includes nearly 130 species of exotic plants (Lesica 2002) or 10 percent of the Park's flora that have been intentionally or inadvertently introduced. A number of these species are increasing in area and density and are threatening native plant communities. They inhibit the perpetuation of native plant communities and consequently impact habitat for wildlife in the Park. Exotics occur in disturbed areas such as roadsides, construction areas, old homesteads, grazed fields, trails, burns, floodplains, and utility sites. Along the Going-to-the-Sun Road weeds are often introduced by vehicles containing weed seed or from construction equipment that hasn't been properly cleaned. The spread of noxious weeds occurs when visitors, construction equipment, animals, wind, and water transport seed and from ground disturbances that remove native vegetation.

Infestations of state-listed noxious weeds are most common at lower elevations of the Going-to-the-Sun Road (GNP exotic database 2001). Within the Lake McDonald Valley, there are 164 acres (66 hectares) of infestation by noxious weeds in the visitor service

zone that borders the Road and developments. These include spotted knapweed, oxeye daisy, Canada thistle, houndstongue, leafy spurge, orange hawkweed, St. Johns wort, Dalmatian toadflax, sulfur cinquefoil, and common tansy. Most of these infestations occur along roadside ditches and at developed areas.

In the St. Mary Valley, there are about 310 acres (125 hectares) of noxious weeds located primarily along the Going-to-the-Sun Road, within developed areas, and within the large fescue meadows. Noxious weeds in the St. Mary Valley include spotted knapweed, oxeye daisy, Canada thistle, houndstongue, St. Johns wort, orange hawkweed, leafy spurge, and common tansy.

Wetlands

Wetlands, including wet meadows, swamps, marshes, and fens, are scattered throughout the Road geographic area. Within the broad Going-to-the-Sun Road corridor, which incorporates both the Lake McDonald and St. Mary Valley areas, there are approximately 13,527 acres (5,475 hectares) of wetlands. This includes 11,698 acres (4,735 hectares) of lacustrine wetlands, 1,052 acres (425 hectares) of palustrine wetlands, and 776 acres (315 hectares) of riverine wetlands.

Lacustrine communities are associated with areas of deep water and are the most common in the Park. These wetlands are often located in topographical depressions or dammed river channels and generally lack substantial amounts of trees or emergent vegetation. These areas include lakes, ponds, and seasonal depressions. Aquatic vegetation, including various pondweeds, cow-lily, water-milfoil, and quillwort are common in lacustrine wetlands.

Palustrine communities include wetlands dominated by trees, shrubs, and persistent emergent plants.

This community includes several types of wetlands such as wet meadows, swamps, marshes, bogs, and fens. Wet meadows that occur in depressions in forests and along lake margins are often dominated by bluejoint reedgrass and willows. Swamps are often dominated by alder and willow and are found along streams and beaver impoundments. Marsh vegetation that develops on saturated to flooded soil is typically dominated by sedges and horsetail. Fens develop in wet organic soils of glacial depressions or gentle slopes associated with ground water seepage and are dominated by sedges.

Riverine wetlands are those associated with rivers, streams, and creeks. Water is usually, but not always, flowing in the riverine system. The vegetation of these communities is typically composed of riparian forest, dominated by black cottonwood, spruce, paper birch, and sometimes western red cedar in the overstory. Willow, red-osier dogwood, alder, hawthorn, mountain maple, aster, horsetail, bedstraw, cow parsnip, sweet cicely, and various grasses are common in the understory.

Surveys of potential wetland areas were conducted at selected sites along the Road corridor near developed areas to determine if wetlands are present near proposed rehabilitation and improvement sites (DeArment 2001). Wetland areas near Apgar, Lake McDonald, Logan Pit, Logan Creek, Rising Sun, and several other sites were evaluated. Information from the wetland inventory will be used to identify areas to avoid during rehabilitation.

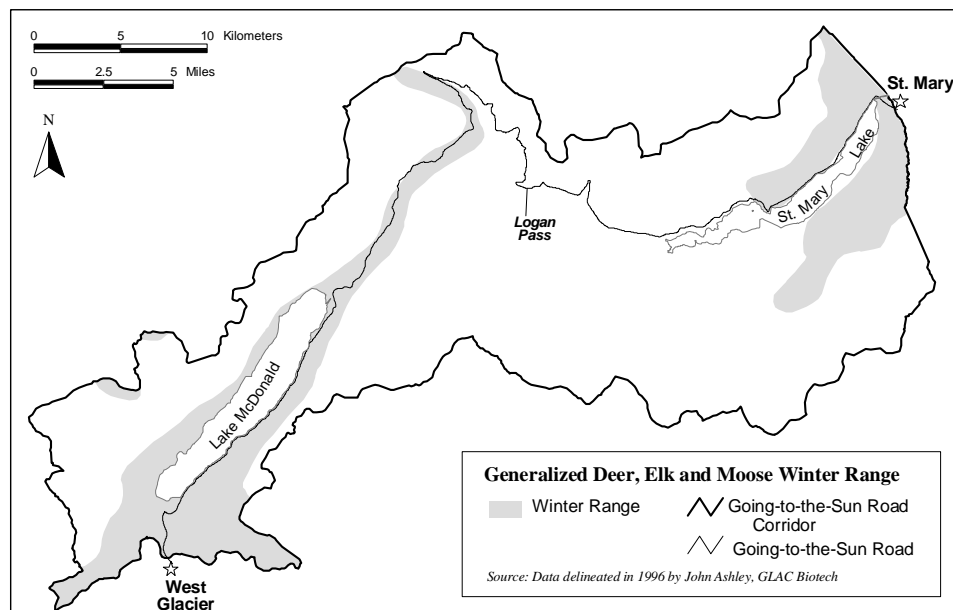
Wildlife Resources

Over 300 species of terrestrial wildlife occupy GNP, either seasonally or year-round. The Going-to-the-Sun Road corridor crosses a diversity of wildlife

habitats from lower elevation montane forests at West Glacier to grasslands at St. Mary to alpine tundra at Logan Pass. Of particular significance to many species of wildlife are riparian areas, travel corridors, avalanche chutes, shrublands, wetlands, meadows, bogs, snags, burns, aspen parklands, old-growth forests, floodplains, mineral licks, birthing areas, hibernacula, den sites, roosts, caves, and cliffs. The Park is one of the few places in the contiguous 48 states that support natural populations of all indigenous carnivores and most of their prey species. Core areas that are large enough to support self-sustaining populations of wide-ranging carnivores, such as wolves, grizzly bears, and lynx, play a key role in maintaining regional biological diversity and native species.

Much of the Going-to-the-Sun Road west of the Continental Divide follows the Lake McDonald Valley, which provides a diversity of habitats valuable for wildlife. Year-round habitat for many species of wildlife can be found in the valley including moose, elk, mule and white-tailed deer, black and grizzly bear, cougar, lynx, fisher, wolverine, marten, and seven of the eight species of reptiles and amphibians that occur in the Park. Deer, elk, and moose winter range is present from West Glacier, at Lake McDonald, and throughout the McDonald Creek drainage adjacent to the Road (Figure 17). Elk use the Apgar area in spring for calving and foraging. The Apgar to West Glacier area also provides a major wildlife travel corridor. Black bear, grizzly bear, elk, deer, mountain lion, fisher, and pine marten have all been observed in this area.

Figure 17. Generalized Deer, Elk, and Moose Winter Range.



The McDonald Valley contains nesting habitat for bald eagles, golden eagles, osprey, pileated woodpeckers, and barred owls. Upper McDonald Creek, above the inlet of Lake McDonald, has been identified as the single most important harlequin duck breeding stream in Montana with about 10 to 12 annual nesting pairs. Additional harlequin duck habitat is present along lower McDonald Creek, lower Snyder Creek, Avalanche Creek, and streams on the east side of the Divide (Figure 18). Muskrat,



Harlequin duck

beaver, mink, river otters, raptors, and waterfowl make use of the highly productive aquatic and riparian habitats along Lower McDonald Creek. Lake McDonald is also a staging area for harlequin ducks, common loons, and numerous other waterfowl.

The biannual raptor migration through the Park is a significant event. During the autumn of 1996, over 3,000 raptors were observed from a single location in the McDonald Valley (Yates et al. 2001).

About 92 percent of the observations were golden eagles and the remainder were bald eagles. The migration of golden eagles through the Park may be one of the largest golden eagle migrations in North America. Several golden eagle nest sites are located near the Going-to-the-Sun Road. Habitat for other raptors, including Cooper's hawk and northern goshawk, is also present along the Road corridor.

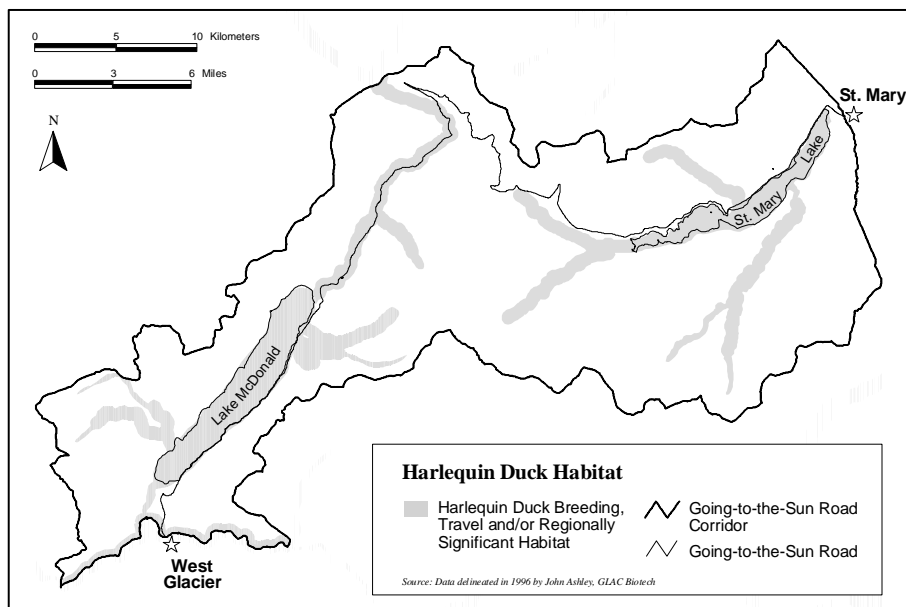
Mountain goats and bighorn sheep are commonly found on rock slopes and cliffs along the Road from near The Loop to Siyeh Bend. They forage on grassy slopes and occasionally along the Road shoulder, which can cause traffic congestion. Mountain goat and bighorn sheep activity between Big Bend and Logan Pass is greatest in the summer and between The Loop and Big Bend is greatest in the late summer and fall. Black bear, mountain lion, wolverine, and coyotes are commonly found throughout the length of the Road. Other mammals common to the area include Columbian ground

squirrel, hoary marmot, mule deer, golden-mantled ground squirrel, red squirrel, and marten.

Because the east side of GNP lies in a transition zone between the Northern Rocky Mountain and Northern Great Plains ecosystems and between the sharply contrasting Pacific Maritime and Continental climatic regimes, wildlife habitat along the east front is notably diverse. The St. Mary Valley provides excellent forage and cover for a variety of wildlife species including grizzly and black bears, mountain lions, lynx, wolverine, coyotes, gray wolves, bald and golden eagles, fisher, marten, and all six ungulate species found in the Park. Boreal toads, spotted frogs, long-toed salamanders, and both species of garter snake occur in the St. Mary Valley and are closely associated with the area's aquatic ecosystems. The east side of the Park provides excellent winter range for bighorn sheep and mountain goats because the strong winds and sparse vegetation leave the south facing slopes relatively snow-free in winter. Bighorn sheep and mountain goats winter in the St. Mary Valley near Rising Sun, often foraging above the Going-to-the-Sun Road. The fescue grasslands scattered throughout the St. Mary Valley provide critical winter range for elk and deer (Figure 17).

The St. Mary elk herd, the largest elk herd in the Park, has historically spent most winters (excepting the harshest) inside of the Park in the St. Mary Valley. More recently, elk have been leaving the St. Mary Valley in late fall to winter out on the plains east of the Park as habitat security levels on the Blackfeet Reservation have risen. An important

Figure 18. Harlequin Duck Habitat.



spring elk calving area lies northeast of the St. Mary campground, and each year the Blackfeet Tribal Fish and Game Department places an access closure on the area to protect elk from human disturbance at this sensitive time. Elk calving also occurs between Rising Sun and the St. Mary campground. In summer, the St. Mary elk herd disperses along the east side of Glacier from Marias Pass north to the Canadian border.



Mountain goat

Review of the earliest Park records suggests that wildlife composition for mammals and birds has changed little since GNP was established, however, several native species are no longer present and other non-native wildlife species have become established. The mountain bison disappeared from the area before the establishment of GNP, and the woodland caribou population disappeared by the 1930's. Non-native species currently present in the Park include raccoon, ring-necked pheasant, wild turkey, rock dove, European starling, and house sparrow. Management of exotic animal species is undertaken wherever such species have a substantial impact on Park resources or human health and when there is a reasonable expectation that these species can be controlled (NPS 2001b). None of the above mentioned species is widespread or abundant, and control actions have not been implemented in the Park.

Aquatic Resources

The natural aquatic systems and associated indigenous fisheries of the Park have been dramatically altered in the last century by introductions and invasion of non-native fish. Although all of the native species are still present in the Park's lakes and streams, species composition and relative abundances have changed significantly. Stocking of non-native sport fish in Park waters began in 1912 and was not terminated until 1972.

The ways in which altered fish communities have affected associated amphibian, aquatic invertebrate, and terrestrial vertebrate populations are not easily described due to a lack of historic data. There is concern that changes in the abundance of native fish may negatively affect the native predators that depend on them, such as bald eagles, river otters, and osprey. Although fish are no longer stocked in the Park's waters, the introduction, invasion, and

establishment of non-native fish species have seriously compromised the Park's aquatic systems (Marnell 1988). As aquatic and terrestrial habitats outside of the Park become more degraded, and as inbreeding with non-native species becomes more prevalent, headwater Parks like Glacier become increasingly important as refuge for pure genetic stocks of fish.

Currently the streams and lakes along the Going-to-the-Sun Road corridor west of the Continental Divide support 11 known native fish species including: westslope cutthroat trout, bull trout, mountain whitefish, pygmy whitefish, reddsideshiner, peamouth, northern pike minnow, longnose sucker, largescale sucker, slimy sculpin, and shorthead sculpin. Five non-native fish species are still present west of the Continental Divide in the Park (rainbow trout, eastern brook trout, kokanee salmon, lake whitefish, and lake trout).

Aquatic habitats along the west half of the Road also provide habitat for amphibious and aquatic invertebrates, vertebrates, and macroinvertebrates. Known amphibious species include long-toed salamanders, tailed frogs, boreal toads, Pacific tree frogs, Columbia spotted frogs, and painted turtles. Several hundred aquatic invertebrate species have been identified in the Park, and scientists believe that many aquatic invertebrate and plankton species are yet to be discovered. Three other aquatic species are known from this area including Columbia spotted frog, boreal toad, and long-toed salamander.

Threatened and Endangered Species and Species of Concern

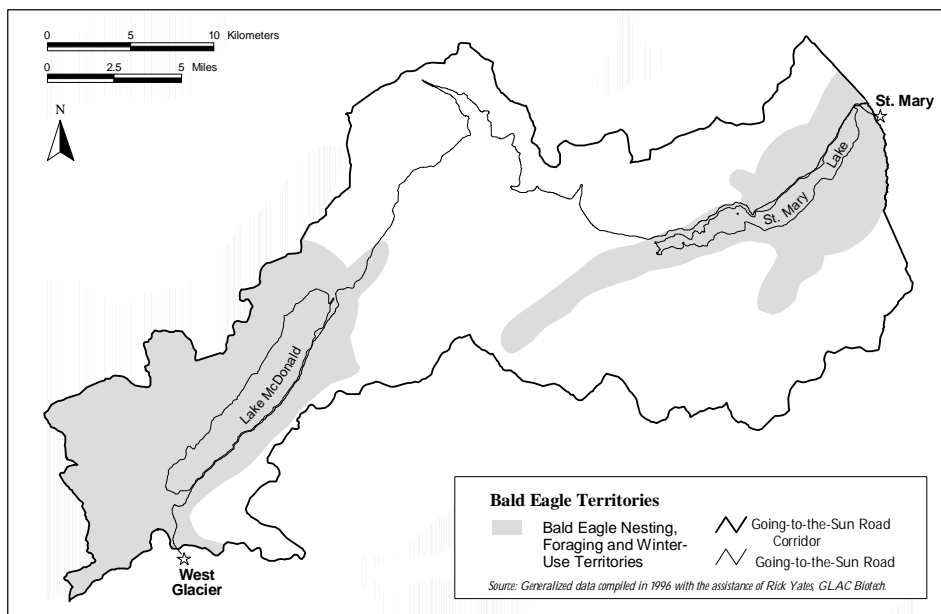
Threatened and Endangered Species

The U.S. Fish and Wildlife Service (FWS) has identified eight threatened, endangered, and

candidate species that may be present in the vicinity of GNP (Table 27). Five of these species are known to occur throughout the Going-to-the-Sun Road corridor, including bald eagle, grizzly bear, lynx, gray wolf, and bull trout.

Bald Eagle. Bald eagles use portions of GNP on a year-round basis as nesting and wintering residents (Yates 1989) and as seasonal migrants (McClelland et al. 1994; Yates et al. 2001) (Figure 19). Two bald eagle nesting territories are located within the Going-to-the-Sun Road geographic area, one at Lake McDonald and one at St. Mary Lake. The inlets of Lake McDonald and adjacent areas provide foraging, roosting, and wintering habitat for resident and migrant bald eagles. The outlet of Lake McDonald also provides an important bald eagle wintering and roosting area. Wintering and roosting habitat at St. Mary Lake is found where large trees are present and near open water where fish and waterfowl are available. GNP also is within a major bald eagle migration corridor and use along the western side of the Park is extensive in the

Figure 19. Bald Eagle Territories.



spring and fall (McClelland et al. 1994).

The bald eagle nesting season in GNP extends from early March through late September. The Montana Bald Eagle Management Plan recommends restrictions on human activity within 0.25 miles (400 meters) of bald eagle nesting, roosting, and primary foraging areas during specific stages of the nesting cycle (Montana Bald Eagle Working Group 1994). Restrictions on activity are implemented during the spring in the Lake McDonald and St. Mary Lake bald eagle nest-site management zones. Foraging habitat outside of nest-site management zones is also important, especially for non-breeding, wintering, and migrant bald eagles (Montana Bald Eagle Working Group 1994).

Grizzly Bear. GNP is part of the recovery area for the threatened grizzly bear in the Northern Continental Divide Ecosystem, and has the highest known density in the recovery area. Preliminary results from a recent study using sign surveys and DNA fingerprinting indicate there is a minimum of 178 individual grizzly bears inhabiting GNP with a total estimated population of 323 individuals



Bald eagle

(Kendall, pers. comm. 2002). Precise population estimates and trends are difficult to establish due to the lack of intensive population level research within the Park and the inherent problems of counting the widely distributed and reclusive grizzly bear.

Grizzly bears require large areas of undeveloped habitat (including a mixture of forests, moist meadows, grasslands, and riparian habitats) and have home ranges of 50 to 500 square miles (130 to 1,300 square kilometers) (FWS 1993). Grizzly bear seasonal movements and habitat use are tied to the availability of different food sources. In spring, grizzly bears feed on dead ungulates and early greening herbaceous vegetation at lower elevations (Martinka 1972). During the summer, some bears move to higher elevations in search of glacier lilies and other roots, berries, and army cutworm moths (White et al. 1998). During the huckleberry season in the late summer and early autumn, bears forage at upper elevation sites, including avalanche chutes east and west of Logan Pass (Figure 20). During the winter, grizzly bears hibernate in dens away from



Grizzly bear

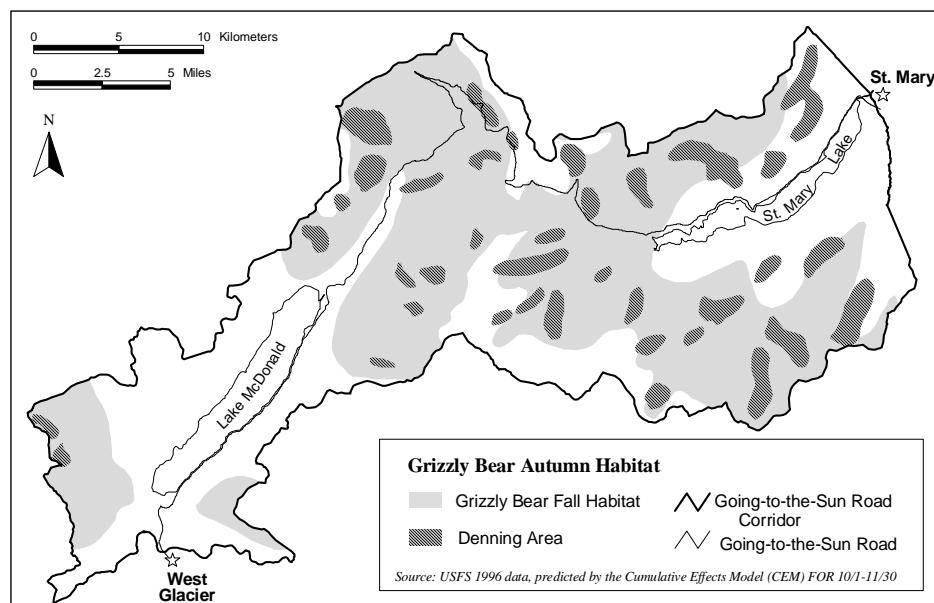
human disturbance, typically at higher elevations on steep slopes where wind and topography cause an accumulation of deep snow (Mace and Waller 1997).

In addition to diverse foraging habitat, grizzly bears require natural habitat that provides security cover for travel between foraging sites. Examples of these types of travel corridors are found in the Logan Creek area, the McDonald Valley near Apgar, and

along Lake McDonald. Grizzlies are wide-ranging and require a substantial amount of solitude from human interactions (Brown 1985).

Grizzly bear/human interaction is a management concern that can threaten the safety of visitors as well as that of wild bears. Bears that are familiar with humans have the potential to become habituated to human presence and may become attracted to visitor use areas (Jope 1985).

Figure 20. Grizzly Bear Autumn Habitat.



Frequenting human use areas may further habituate bears to the presence of people and will increase the risk of contributing to bear/human encounters. Habituated bears are at great risk of also becoming food-conditioned and may aggressively seek human

food at developed areas. Habituated bears are usually relocated from developed areas, and food-conditioned bears are oftentimes removed from the population.

Table 27. Federally listed threatened and endangered species evaluated for potential occurrence near the Going-to-the-Sun Road.

Common Name	Scientific Name	Status	Habitat	Potential for Occurrence near the Road
Bald eagle	<i>Haliaeetus leucocephalus</i>	FT	Open water, large trees for nesting or roosting	Present, two nest sites in the Road corridor at Lake McDonald and St. Mary Lake, roost site near Snyder Creek
Grizzly bear	<i>Ursus arctos</i>	FE	Diversity of habitats including coniferous forest, avalanche chutes, riparian areas, meadows	Present, suitable habitat throughout the Park
Gray wolf	<i>Canis lupus</i>	FE	Forests and meadows where an adequate ungulate prey base is available	Found in North Fork area and McDonald Valley; range may include portions of the western Road corridor and St. Mary area
Lynx	<i>Lynx canadensis</i>	FT	Coniferous subalpine forest	Present, observations and tracks observed on both sides of the Park
Bull trout	<i>Salvelinus confluentus</i>	FT	Lakes and rivers	Present in McDonald Creek, Lake McDonald, and St. Mary drainage
Water howellia	<i>Howellia aquatilis</i>	FT	Vernal glacial ponds and oxbow sloughs	Suitable habitat, but no known populations in the Park
Spalding's catchfly	<i>Silene spaldingii</i>	FT	Open rough fescue and bluebunch wheatgrass grasslands	No suitable habitat
Slender moonwort	<i>Botrychium lineare</i>	FC	Open meadows, under trees, roadside ditches, limestone cliffs	Possible, suitable habitat present

FE = Federally Endangered; FT = Federally Threatened; FC = Federal Candidate

Source: FWS 2001

Gray Wolf. The natural landscapes in GNP contain some of the most secure and productive wolf habitat in northwest Montana. After a long absence, wolves from Canada began recolonizing the Park in the 1980's (Rockwell 1995; Ream et al. 1989). Wolves have been reported from every major drainage in the Park, but their activity has been mostly concentrated in the North Fork area. Two wolf packs with a total

of 10 to 33 wolves have maintained home ranges in the North Fork area throughout the 1990s. Recent sightings document two wolf packs occupying the North Fork and a third pack in the McDonald Valley area. Additional sightings and historic records for the east side of the Park suggest wolves are in the process of recolonizing the area. Pack activity has recently been observed in the St. Mary, Many

Glacier, and Two Medicine areas. No gray wolf denning is known in the Going-to-the-Sun Road corridor. Despite fluctuating wolf numbers since 1986, the Park's established wolf population continues to serve as a source for natural recolonization in northwest Montana and southern Canada (Boyd-Herger 1997).

Gray wolves are wide-ranging and their distribution is tied primarily to that of their principal prey (deer, elk, and moose). Key components of wolf habitat are: 1) a sufficient, year-round prey base of ungulates and alternate prey; 2) suitable and somewhat secluded denning and rendezvous sites; and 3) sufficient space with minimal exposure to humans (FWS 1987). Wolves are especially sensitive to disturbance from humans at den and rendezvous sites during the breeding period. Human activity near den sites can lead to pack displacement or physiological stress perhaps resulting in reproductive failure or pup mortality (Mech et al. 1991).

Lynx. Historically lynx may have been more common throughout GNP; documented sightings declined since the 1960's but appear to be increasing in recent years, perhaps due to an increased interest in the species. Systematic surveys since 1994 detected lynx in many of the Park drainages, including the St. Mary and McDonald valleys. The



Lynx

number of lynx currently present in the Park is not known.

Lynx habitat generally is described as climax boreal forest with a dense undercover of thickets and windfalls (Ruediger et al. 2000). Advanced successional stages of forests and dense conifer stands often are preferred habitats of lynx for denning and foraging respectively. Large amounts of woody debris and minimal human disturbance are important features of denning sites (Brittel et al. 1989). Lynx generally forage in dense young conifer forests or mature forest in more open stands especially, where their primary prey, snowshoe hare (*Lepus americanus*), is abundant. Travel corridors are thought to be an important factor in lynx habitat because of their large and variable home ranges, generally 3 to 285 square miles (8 to 738 square kilometers) (Ruediger et al. 2000). Travel cover includes contiguous vegetation cover over 6 feet (2 meters) tall (Brittel et al. 1989), and lynx generally do not cross openings greater than 300 feet (100 meters) wide (Koehler 1990). Lynx are most susceptible to disturbance during the denning period and while newborns are developing (May–August) (Joslin and Youmans 1999). Generalized lynx habitat has been delineated in GNP, but there is little information on occupancy or population numbers.

The primary risk factors for lynx near GNP are: wildland fire management policies that preclude natural disturbance processes, roads and highways, winter recreational trails, habitat degradation by non-native plant invasive species, incidental or illegal shooting and trapping, competition or predation as influenced by human activities, and human developments that degrade and fragment habitat.

Bull Trout. The North Fork and Middle Fork of the Flathead River drainages and portions of the Hudson Bay drainage, which includes the Belly River and St.

Mary drainages, contain lake and stream habitat for bull trout. Within the Going-to-the-Sun Road corridor, bull trout are present in Lake McDonald and McDonald Creek. Bull trout have experienced significant population declines in the Lake McDonald/Flathead drainage due to competition and hybridization with introduced, non-native fish species such as lake trout and eastern brook trout. Most of the bull trout population in the Park's lakes is currently at a high risk of extirpation due to displacement by lake trout (Fredenberg 2000). Present fishing regulations prohibit the taking of any bull trout in GNP.

Bull trout exhibit three distinct life-history forms—resident, fluvial, and adfluvial. Resident bull trout spend their entire lives in small tributaries, whereas fluvial and adfluvial forms hatch in small tributary streams then migrate into larger rivers (fluvial) or lakes (adfluvial). Spawning occurs in third and fourth order streams between late August and early November (FWS 1998). Eggs and fry typically overwinter in spawning streams until the following spring. Specific habitat requirements of bull trout include abundant cover for adult fish during spawning, low levels of fine sediment in the incubation environment, cold summer water temperatures and channel stability for juveniles, and open migration routes between seasonally important habitats (FWS 1998).

Plants. There are no known federally listed threatened or endangered plants in the Park. Suitable wetland habitat for the federally threatened water howellia is present in the Park, but it has not been observed. Spalding's catchfly is present in the Upper Flathead River drainage, but no potential habitat for the species has been identified in the Park. Slender moonwort is a candidate plant species for federal listing, that has been located in the Park, but not within the Going-to-the-Sun Road corridor, although suitable habitat is present.

Species of Concern

Species of concern to GNP are those species that are rare, endemic, disjunct, vulnerable to extirpation, in need of further research, or likely to become threatened or endangered if limiting factors are not reversed. Likewise, a species may be of concern because of characteristics that make them particularly sensitive to human activities or natural events. The species of concern list for GNP includes species that are listed as "Species of Special Concern" by the Montana Natural Heritage Program (MNHP), "Priority Species" by Partners in Flight, and "Sensitive Species" by the U.S. Forest Service (USFS). In addition, species of concern may also include big game, upland game birds, waterfowl, carnivores, predators and furbearers whose populations are protected in the Park but subject to hunting and trapping outside of the Park. A complete list of wildlife and plants of concern is included in Appendix C.

Wildlife and Aquatic Species. There are 63 wildlife and aquatic species of concern that are known to use or inhabit the Going-to-the-Sun Road corridor.

Coniferous forests near the Road may support several species of concern including fisher, wolverine, Clark's nutcracker, golden eagle,



Rocky Mountain bighorn sheep

Hammond's flycatcher, pileated woodpecker, and three-toed woodpecker. Numerous species of concern may use riparian and wetland habitat along McDonald Creek, Reynolds Creek, and their tributaries including, northern bog lemming, silver-haired and hoary bats, harlequin duck, red-eyed vireo, willow flycatcher, black-backed woodpecker, and boreal toads. Ptarmigans and bighorn sheep are found in alpine habitats near Logan Pass. Wolverine use forest mosaic and subalpine talus sites and also frequent ungulate winter range in search of carrion. Lake McDonald and St. Mary Lake provide habitat for horned grebe, common loon, and trumpeter swan. The St. Mary drainage also supports several aquatic species including Rocky Mountain capshell, shorthead sculpin, spoonhead sculpin, and trout-perch. West slope cutthroat trout is found on both sides of the Park. Grasslands near St. Mary may support ferruginous hawk and swift fox.

Plants. There are 74 plant species of special concern, as designated by the MNHP, located in the Going-to-the-Sun Road geographic area. This includes 39 species of vascular plants, 33 mosses, and 2 lichens. Plants of special concern are found in all of the habitats present along the Road including coniferous forest, streamside riparian areas, moist meadows, dry grasslands, and alpine tundra. Many of the rare plants are found in wetlands, bogs, and peatlands. The steep rocky slopes adjacent to the Road at higher elevations support a variety of rare vascular plants and mosses adapted to wet rocks and limestone outcrops.

Air Quality

GNP is classified as a mandatory Class I area under the Federal Clean Air Act (42 USC 7401 *et seq.*). This most stringent air quality classification is aimed at protecting parks and wilderness areas from air quality degradation. The act gives federal land

managers the responsibility for protecting air quality and related values, including visibility, plants, animals, soils, water quality, cultural and historic structures and objects, and visitor health from adverse air pollution impacts. The Clean Air Act defines mandatory Class I areas as national parks over 6,000 acres (2,428 hectares) and wilderness areas over 5,000 acres (2,023 hectares) designated as of the date of the act.

Existing air quality is considered good in the Park. The annual visibility levels at the Park are approximately 52 miles (84 kilometers), which is less than typical in the Central Rocky Mountains but greater than many eastern sites. Impaired visibility results from concentrations of fine particles suspended in the ambient air. Fine aerosol and coarse aerosol concentrations averaged 5.5 micrograms per square meter ($\mu\text{g}/\text{m}^3$) each. There are no strong seasonal variations except for nitrate, which showed a strong winter peak, and coarse mass, which peaked in winter. Organics are by far the largest contributor to fine particle mass (58.4 percent) followed by sulfate (17.9 percent), soil (10.4 percent), light-absorbing carbon (7.7 percent), and nitrate (5.6 percent). The organic and soot particles originate from vegetative burning and urban sources; sulfates and nitrates originate from sources of sulfur dioxide and nitrogen oxides, such as power plants; and coarse mass and soils come from wind blown dust.

Visibility is affected by wildfires, prescribed fires, and industrial emissions from sources in the northern states and Canadian provinces on the boundary (IAQAB 1998). Dust from unpaved roads in the Park also affects visibility. Sulfuric compounds from industrial emissions, including sulfur dioxide and ammonium sulfate, also can contribute to local haze. When inversions occur, visibility problems in the Park can be more severe. Flathead County, which includes the part of the Park west of the

Continental Divide, is currently out of compliance with Montana standards for particulate emissions. Montana is required to develop a state implementation plan to attain the particulate standard.

Sulfate and nitrate ion concentrations in precipitation measured at the Park are comparable on average to other sites in the northwestern United States but are very low compared to most sites in the eastern United States. In 1997, the Park reported a sulfate ion concentration of 0.3 milligrams per liter (mg/L) and a nitrate ion concentration of 0.5 mg/L.

The annual maximum 1-year ozone levels at GNP are lower than those measured at most of the other monitoring sites in the national park system. Between 1992 and 1997, the Park's annual daily maximum 1-hour concentrations varied between 58 and 77 parts per billion (ppb). The Park's peak ozone levels are comparable to those measured at other national park system sites in the Pacific Northwest but are significantly lower than those measured in national parks system sites in southern California and in the northeast and east-central United States. In addition, the Park's ozone levels are well below the U.S. Environmental Protection Agency (EPA) 8-hour average ozone standard designed to protect human health.

Winter inversions cause local increases in carbon monoxide at Kalispell, 13 miles (21 kilometers) south of West Glacier. Emissions from automobiles, wood-burning stoves, and the Columbia Falls Aluminum Company, combined with winter meteorological conditions, cause seasonal increases in carbon monoxide.

The main sources of pollutants surrounding the Park west of the Continental Divide are industrialized areas south and west of the Park, including Columbia Falls Aluminum Company, Plum Creek Lumber, Stoltze Land and Lumber, and Pack and

Company. These sources are under the authority of the state of Montana, which works closely with the Park on air quality issues. On the east side of the Park, airborne pollutants are often associated with a northern airflow.

Visual Resources

The Road is characterized by majestic views as it follows the shore of Lake McDonald and climbs through subalpine slopes to the summit at Logan Pass. From Logan Pass, the Road winds down the east side of the Continental Divide along St. Mary Lake to the community of St. Mary. The panoramic views of the natural environment provided by the Road are complemented by the excellent examples of craftsmanship used in Road construction. The Road boasts numerous complex retaining walls, long stretches of protective guardwalls, and a stone arch half-bridge and stone bridges that blend into the surroundings.

The Going-to-the-Sun Road is a key component of a complex and dramatic visual landscape. The Road offers spectacular views of mountains, lakes, streams, and forestland well beyond the roadway corridor. Important cultural landscapes such as historically significant engineering features are observable throughout the Road. In addition, the Road is visible to Park users other than motorists from vantage points along trails, lake shorelines, lodges, campgrounds, and other visitor facilities. In discussing the visual landscape of the Road corridor, views both of the Road and from the Road, for both distant and short-range views, come into play. These varied scenic opportunities are examined in detail in the *Cultural Landscape Report* for the Road, which was prepared in conjunction with the Road rehabilitation planning effort (RTI 2002).

Views of the Road and its immediate setting are available throughout the roadway corridor. For

motorists, short-range views of the Road are ubiquitous, demonstrating the Road's unique engineering and the surrounding natural environment. Defining visual qualities of the Road include its relative narrowness and often-tight curvature; the use of rustic designs and natural materials in walls and railings; distinctive signage; and pullouts. These elements distinguish the Road from driving experiences elsewhere. The high elevation portions of the Road create a dramatic cut across the steep landscape visible from trails, picnic sites, and other locations off the Road corridor.

While some visual qualities of the Road are present throughout its length, specific roadway characteristics vary significantly in response to the Road's changing natural setting. Logan Pass provides the Road's most spectacular and characteristic visual features. Here, views of the Road emphasize narrowness and curvature, with often-limited sight lines and virtually no shoulders. Road-related engineering features, such as retaining walls and guardwalls, are very frequent, and often highly visible to travelers. The design of these structures, and their use of native materials, provide the Road with some of its most noteworthy visual qualities and integrate the route into its dramatic natural setting. Another distinguishing element of the Road is the fairly constant 6 percent grade on either side of the pass.

The lower segments of the Road provide a less complicated topography requiring fewer engineering features with broader curvature, visible shoulders, and improved sight lines; however, a number of characteristic engineering features exists in these areas, and the Road's width, signage, and other features continue to mark the route as a national park roadway.

More distant views of the Road are relatively limited for motorists. Vegetation and topography obscure

most panoramic vistas of the immediate roadway corridor, except for the Alpine section of the Road, where the exposed, cliffside alignment makes the Road a prominent feature of the Logan Pass approach. On the western approach to Logan Pass, the Road is several miles away, over 2,000 feet (600 meters) above, and clearly visible to eastbound travelers on the McDonald Valley floor. Hikers and mountain climbers experience similar views of the Road from a number of locations including the popular Highline Trail.

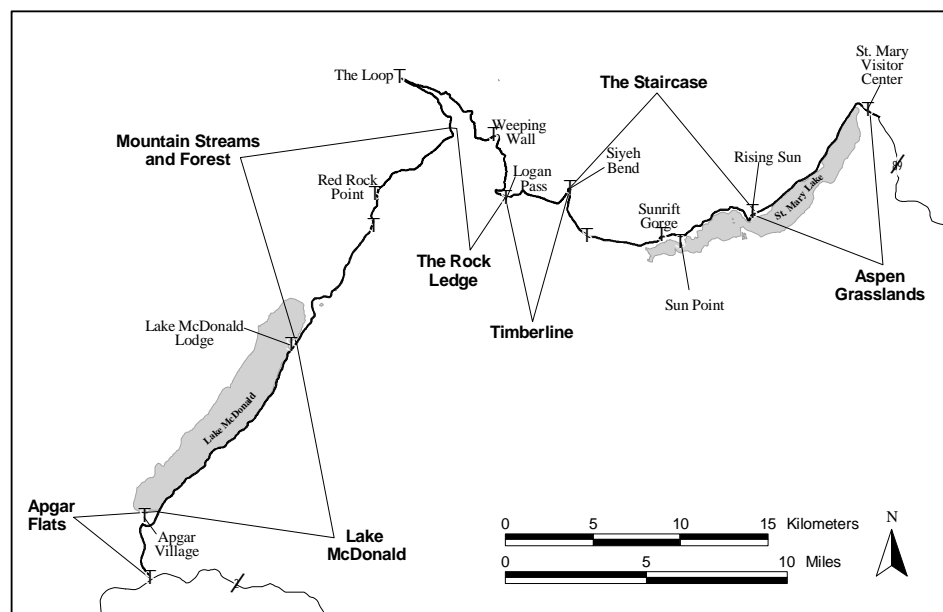
The Road also provides views of the natural and cultural features beyond the Road corridor. For much of its length, the Road provides dramatic visual exposure to the Park's natural and scenic features, successfully fulfilling its primary design mission and maintaining its role as a primary visitor attraction in Glacier.

The *Cultural Landscape Report* (RTI 2002) identified seven "landscape segments" for the Road, each with its own distinguishing visual characteristics. These segments are summarized in Table 28 and shown in Figure 21.

Table 28. Going-to-the-Sun Road landscape segments (west to east).

Name	Location
Apgar Flats	West Glacier to the foot of Lake McDonald
Lake McDonald	Foot of Lake McDonald to Lake McDonald Lodge
Mountain Streams and Forests	Lake McDonald Lodge to base of Logan Pass grade
The Rock Ledge	Base of Logan Pass grade to Logan Pass
Timberline	Logan Pass to Siyeh Bend
The Staircase	Siyeh Bend to Rising Sun
Aspen Grasslands	Rising Sun to St. Mary

Figure 21. Cultural Landscape Segments.



The **Apgar Flats** segment is the western gateway to GNP and the first exposure to the Road for most Park visitors. A combination of 1930s and 1960s construction projects, this segment displays little of the visual character that marks the remainder of the Road. The roadway is relatively wide, with broad, sweeping curves and almost no visible engineering features. The forests surrounding the Road inhibit scenic views in nearly all directions, focusing visual attention on the roadway itself. The Headquarters and Apgar areas are nearby, but are not visible from the Road.

With the **Lake McDonald** segment, the visual character of the roadway changes significantly as it follows the southeastern shore of the Park's largest lake. This segment, on an historic alignment largely dating from the 1930s, features a narrow width and near-constant curvature. The visual character of the Lake McDonald segment is defined by the Road's tight placement between lakeshore and hillside. The intermittent views of Lake McDonald include the first glimpses for eastbound travelers of the Park's famous mountain peaks. Views of the roadway

itself are limited to the immediate area. The segment ends at Lake McDonald Lodge, a National Historic Landmark only briefly visible through the forest.

The **Mountain Streams and Forests** segment marks the Road's transition from lakeshore to streamside and canyon surroundings. The increasing closeness of the Park's mountains is a defining characteristic of this segment, and

eastbound travelers are treated to intermittent but spectacular vistas of Glacier's peaks. These panoramas are juxtaposed with shorter-distance views of cascading McDonald Creek and nearby forests. A visual sense of the Road's engineering quality also begins to emerge here, with the presence of the first stone guardwalls, retaining walls, and bridges. Occasional long straight-aways help make the roadway visible, and frame some of the segment's best vistas. Eastbound travelers on the segment can also view the Road alignment ascending Logan Pass on the cliffs far above.

The **Rock Ledge** segment begins as the Road starts its ascent to Logan Pass just east of Logan Creek. With little change from the 1920s, this alignment climbs to the Pass. This segment is easily the most spectacular, and dramatically displays the visual and engineering qualities for which the Road is famous. The Road here is characterized by a very narrow width, largely without shoulders, heavy curvature, and long stretches of stone guard and retaining walls. Views from the Road are expansive, with broad mountain vistas to the north, views down

McDonald Creek to the west, and of Logan Pass to the south. Both close-range and distant views of the Road and its historic stonework are also afforded, providing strong visual reflections of the route's complex, dramatic, and sensitive engineering.

The **Timberline** segment represents the eastern counterpart to the Rock Ledge ascent to Logan Pass. As with the Rock Ledge segment, the Timberline segment includes cliffside construction with significant exposure, but the roadway is wider, curves are broader, and the rockwork generally less prominent. Distant views predominate, although the panoramas are less broad than those to the west. The relatively direct alignment and lack of trees combine to make the Road visible in this area.

The **Staircase** segment begins where the Road re-enters the forest at Siyeh Bend. This segment includes long straight-aways to the west, and narrow, relatively tight curves along the north shore of St. Mary Lake. Views are intermittent, although the lakeshore portion of the segment includes spectacular vistas of St. Mary Lake and the mountains beyond. Significant masonry engineering features exist on this segment, although they are less visually prominent than those nearer Logan Pass. Medium-range views of the Road are relatively frequent, both in the straight-aways and along the St. Mary lakeshore.

The **Aspen Grasslands** segment again provides a transition between Park and non-park driving experiences. Here, the roadway is relatively straight, with few engineering features. The grassland setting affords numerous distant views, including exceptional vistas of the Park mountains for westbound travelers. The Road itself is also readily apparent, although the straightforward engineering of the segment limits its visual interest.

Natural Soundscape and Lightscape

An important policy of the NPS is “to preserve, to the greatest extent possible, the natural soundscapes of parks” (USDI 2001). The natural soundscapes exist in the absence of human-caused sound. They are an important resource and have intrinsic value as a part of the unique environment of the Park. Natural sounds of wind, water, animals, and other natural phenomena predominate through most of the Park. Natural sounds occur within and beyond the range of sounds that humans can perceive. Examples of such natural sounds include sounds produced by: wind in the trees, falling water, the rustling of leaves, the song of a bird, the call of an animal, and the buzz of an insect. Natural quiet exists when the sounds of these natural components of the Park prevail.

Artificial noise in the Park originates from human activities and varies depending on time and location. Sources of noise in the Park include road traffic, motorboats, scenic air tours, railroad traffic, developed area activity, and that generated by general maintenance and administrative activities (e.g., chainsaw work, helicopter flights, emergency vehicle sirens). Elevated noise levels are generally concentrated in visitor service zones near campgrounds, lodges, roads, and developed areas. Noise from commercial, private, and military aircraft can be heard throughout the Park. Future development outside the Park, including mineral development, logging, and new construction, also may lead to increased noise within the Park.

Noise is most elevated in the visitor service zones adjacent to the Going-to-the-Sun Road, especially in the Apgar Village, Lake McDonald, and Rising Sun developed areas. Traffic, motorboats, people, and music can contribute to noise in these areas. Noise along the Road is primarily from vehicles and people. The backcountry is dominated by natural

quiet. The only baseline data for measured levels of noise in GNP were gathered by a 1984 study of seismic activity in the North Fork (NPS 1993c). The study indicated an extremely low background level of noise.

There are no major metropolitan areas within 125 miles (200 kilometers) of the Park that substantially affect ambient light conditions. The night sky in GNP remains in a near natural condition. Within the Park, night lighting is limited to developed areas near lodges, stores, and administrative facilities.

About 95 percent of the Park is proposed as wilderness, where natural quiet and natural light are considered important resources. NPS strives to preserve the natural sounds and light associated with the biological resources of the Park. Activities causing excessive noise or unnecessary natural sounds or light are monitored, and actions are taken to prevent or minimize unnatural sounds and light that adversely affect Park resources, values, or visitors enjoyment of them.

Wilderness and Wild and Scenic Rivers

Over 95 percent of GNP has been proposed for wilderness designation, but formal designation has not been signed. NPS policy is to manage proposed wilderness as wilderness until the land is either formally designated or formally rejected by Congress. The Going-to-the-Sun Road, as well as other primary roads in the Park are not included in the proposed wilderness designation. The Road does provide access to proposed wilderness via trailheads.

The three forks of the Flathead River were designated by Congress in 1976 as part of the Wild and Scenic River System. Both the North and Middle Forks of the Flathead River border the Park.

Only the Middle Fork intersects the Going-to-the-Sun Road near West Glacier. The high water line on the Park side of the Middle Fork is the property boundary for the Park and the start of the Going-to-the-Sun Road. Recreation opportunities on the Middle Fork include boating, fishing, and scenic viewing.

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